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Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE

VOL. LXXXV, NO. 1

ANNOTATED LIST OF THE TYPES OF POLYCHAETOUS ANNELIDS IN THE MUSEUM OF COMPARATIVE ZOÖLOGY

BY OLGA HARTMAN

University of Southern California

WITH THREE PLATES

CAMBRIDGE, MASS., U.S.A.

PRINTED FOR THE MUSEUM

NOVEMBER, 1938

PUBLICATIONS

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

AT HARVARD COLLEGE

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The BULLETIN and MEMOIRS are devoted to the publication of original work by the Officers of the Museum, of investigations carried on by students and others in the different Laboratories of Natural History, and of work by specialists based upon the Museum Collections and Exploration.

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No. 1. — *Annotated List of the Types of Polychaetous Annelids in the Museum of Comparative Zoology* [1]

By Olga Hartman

Bibliographic source, museum catalog numbers and type locality are given for ready reference. Synonyms are enclosed in brackets. New synonyms are preceded by an asterisk, uncertain ones by a question mark. Comments are made only on those types where changes of name are made and which have not been treated since first described.

In some specimens, for example the Ehlers' 1868 types, it is not certain that the specimens designated "types" are actually the holotypes. Also, with several of the Chamberlin, 1920 types, paratypes are included because it is not certain that the holotypes are still extant. A considerable number of types that have been reported as deposited in the Museum have not been found in the collections. They are not included in this paper. Many of the Ehlers' 1887 types, from Florida and vicinity, are dried or badly disintegrated. Little can be added to what is known of them without further collecting in the type localities.

Two genera of the family SABELLIDAE which are represented by species in considerable confusion, and for which important type materials are in the Museum, are taken up separately at the end of this paper. These genera are *Eudistylia* Bush and *Pseudopotamilla* Bush.

Thirty families of polychaetous annelids out of a total of fifty-seven families are represented by types in the Museum. These include 160 species, of which 40 are here regarded as synonyms. Eleven others are questionably synonyms also. This leaves a total of 119 types of valid species.

The following list is arranged alphabetically under family names.

APHRODITIDAE

Aphrodita acuminata Ehlers, 1887, pp. 30–42, pl. 5, figs. 1–5; M.C.Z. nos. 737, 1512, 2082, 2200; Florida.

*[*Aphrodita leioseta* Chamberlin] 1919b, p. 254; M.C.Z. no. 14; California, is identical with *A. japonica* Marenzeller. Monro (1933, p. 12) has already commented on the identity of *A. leioseta* and *A.*

[1] I beg to thank the Museum of Comparative Zoology for enabling me to spend two months in Cambridge, in the fall of 1937. Without the opportunity to examine the type material it would have been impossible to settle the various questions of synonymy dealt with in this paper.

solitaria Essenberg (1917, p. 408). Both appear to be the same as *A. japonica.*

Aphrodita obtecta Ehlers, 1887, pp. 42–44, pl. 6, figs. 1–8; M.C.Z. no. 723; Florida.

Lactmoniee nuchipapillata Augener, 1906, pp. 101–113; pl. 1, figs. 2–7; M.C.Z. no. 2205; West Indies.

Pontogenia maggiae Augener, 1906, pp. 103–106, pl. 1, figs. 8–15; M.C.Z. no. 2127; West Indies.

Pontogenia sericoma Ehlers, 1887, pp. 46–48, pl. 7, figs. 1–5; M.C.Z. no. 818; Havana.

POLYNOIDAE

*[*Arctonoë lia* Chamberlin] 1920, pp. 6–7, pl. 1, figs. 1–4, pl. 2, figs. 1–3; M.C.Z. paratypes 2190, 2191; Alaska, is identical with *A. vittata* (Grube). The paratypes compare favorably with specimens of *A. vittata* collected from the branchial grooves of *Cryptochiton* and other hosts from California. The name *Arctonoë* Chamberlin is retained because it has priority over *Halosydnoides* Seidler (see also Hartman, on the types of Polynoidae in U.S.N.M., in press, 1937).

*[*Halosydna leiosecta* Chamberlin 1919a, pp. 2–3; M.C.Z. no. 2140; California, is identical with *Arctonoë pulchra* (Johnson), new comb. Chamberlin's description, as also the type specimen, agrees in detail with the characters of *A. pulchra.* This species, like *Arctonoë vittata,* is a west coast commensal, commonly found with a holothurian, more rarely with other echinoderms.

Halosydna latior Chamberlin, 1919a, pp. 1–2; M.C.Z. no. 2138; California, is readily distinguished by its broadly imbricated, reniform scales, the heavy marginal fringe, and the greatly elongated nephridial papillae.

Harmothoë iphionelloides Johnson, 1901, pp. 391–392, pl. 1, figs. 2–7; M.C.Z. no. 1897; Washington.

*[*Hesperonöe senilis* Chamberlin] 1919b, pp. 252–254, pl. 1, figs. 1–4; M.C.Z. no. 179a; California, is identical with *Hesperonoë complanata* (Johnson). The scales are pale, ornamented with uniformly distributed, fine prickles. I have found the species commensal with *Callianassa californiensis* Dana, in San Francisco Bay. The closely related *H. adventor* (Skogsberg) has smooth scales, the body is notably more depressed, and it is commensal with *Urechis caupo* Fischer and McGinitie.

Lepidametria gigas (Johnson) 1897, pp. 172–175, pl. 7, figs. 33, 42, pl. 8, figs. 48, 49; M.C.Z. no. 964; California.

Lepidonotus citrifrons Augener, 1906, pp. 113–115, pl. 2, figs. 31–38, pl. 3, figs. 39, 40; M.C.Z. no. 2121, 2227, 2228; West Indies.

Lepidonotus lacteus (Ehlers) 1887, p. 52, pl. 9, figs. 1–7; M.C.Z. nos. 786, 1096, 2009; Florida (see Seidler, 1924, p. 34).

Lepidonotus leius Chamberlin, 1919a, p. 4; M.C.Z. no. 2142; California.

Lepidonotus setosior Chamberlin, 1919a, pp. 3–4; M.C.Z. no. 2141; California.

Lepidonotus (*Thormora*) *taeniatus* (Ehlers) 1887, pp. 51–52, pl. 10, figs. 1–8; M.C.Z. no. 1251; Florida (see Seidler, 1924, p. 92).

Nemidia antillicola Augener, 1906, pp. 126–128, pl. 3, figs. 53–59; M.C.Z. nos. 2105, 2120; West Indies.

Polynoella pachylepis Augener, 1906, pp. 120–122, pl. 3, figs. 48–52; M.C.Z. nos. 2018, 2232; West Indies.

POLYODONTIDAE

[*Euarche tubifex* Ehlers] 1887, pp. 54–56, pl. 12, figs. 1–7, pl. 13, fig. 1; M.C.Z. no. 659; Florida, is identical with *Eupanthalis kinbergi* McIntosh (see Monro, 1928, p. 568).

SIGALIONIDAE

Psammolyce floccifera Augener, 1906, pp. 109–113, pl. 2, figs. 24–30; M.C.Z. nos. 2107, 2113; West Indies.

Sigalion pourtalesii Ehlers, 1887, pp. 57–60, pl. 15, figs. 1–4; pl. 16, 1–10; M.C.Z. nos. 37, 813; Florida. Chamberlin (1919c, p. 91) reported this species from the Gulf of Mexico. Treadwell's record (1914, p. 183) from southern California, is presumably not this species. One specimen, from Ballast Point, San Diego, so labelled in the collections of the University of California at Berkeley, differs from *S. pourtalesii* Ehlers in at least the following respects: (1) The superior part of the neuropodial lobe is drawn out in a point, and (2) the parapodia are proportionately longer than in *S. pourtalesii*.

Sthenelais simplex Ehlers, 1887, pp. 60–63, pl. 13, figs. 2, 3, pl. 14, figs. 1–6; M.C.Z. no. 772; Florida.

Sthenelais verruculosa Johnson, 1897, p. 187, pl. 9, fig. 62, pl. 10, figs. 65–65d; M.C.Z. no. 1939; California north to British Columbia (see Berkeley 1923, p. 216).

AMPHINOMIDAE

[*Chloeia euglochis* Ehlers] 1887, pp. 18–24, pl. 1, figs. 1, 2, pl. 2, figs. 1–8, pl. 3, figs. 1–4; M.C.Z. nos. 617, 664, 720; Florida, is identical with *C. viridis* Schmarda (see Monro, 1933, p. 9).

EUPHROSINIDAE

Euphrosine triloba Ehlers, 1887, pp. 31–33, pl. 4; M.C.Z. no. 1250; Florida.

PHYLLODOCIDAE

[*Phyllodoce oculata* (Ehlers)] 1887, pp. 135–140, pl. 40, figs. 4–6; M.C.Z. no. 795; Florida, is an *Anaitides* (see Bergström, 1914, p. 144), identical with *Lepadorhynchus erythrophyllus* Schmarda (see Augener 1925, pp. 23–24). Schmarda's type came from Jamaica.

Paranaitis papillosa (Ehlers) 1887, pp. 140–142, pl. 40, figs. 7–9; M.C.Z. no. 839; Florida, was originally described as *Anaitis*.

Steggoa gracilior Chamberlin, 1919a, pp. 5–6; M.C.Z. no. 2144; California.

HESIONIDAE

Castalia hesionides Augener, 1906, pp. 155–157, pl. 6, figs. 106–109; M.C.Z. no. 2012; West Indies.

[?*Hesione vittigera* Ehlers], 1887, pp. 143–147, pl. 41, figs. —6; M.C.Z. no. 837; Florida, as also *H. praetexta* Ehlers, (see below) is seemingly identical with *H. protochona* Schmarda. Ehlers has already suggested this possibility in his original description.

[*Hesione praetexta* Ehlers] 1887, p. 147; M.C.Z. no. 762; Florida, is identical with *H. vittigera*. They were separated on the basis of color. Ehlers has already discussed their possible identity.

SYLLIDAE

Branchiosyllis oculata Ehlers, 1887, pp. 148–151, pl. 39, figs. 1–7; M.C.Z. no. 844; Florida.

Campesyllis minor Chamberlin, 1919a, p. 10; M.C.Z. no. 2151; California.

Hesperalia californiensis Chamberlin, 1919a, p. 9; M.C.Z. no. 2149; California.

Hesperalia nans Chamberlin, 1919a, pp. 9–10; M.C.Z. no. 2150; California. This may represent the epitokous stage of *Hesperalia californiensis* Chamberlin. The latter is one of the commonest of Syllidae in the littoral zone of southern California.

Pionosyllis elongata Johnson, 1901, pp. 403–405, pl. 6, figs. 67–70, pl. 7, fig. 71; M.C.Z. no. 1937 (cotype); Washington. Common in the littoral zone of the northeast Pacific. Berkeley (1938, p. 41) has enhanced the description and rendered it distinguishable from that of nearly related species.

Pionosyllis lucida Chamberlin, 1919a, p. 8; M.C.Z. no. 2180; California.

Pionosyllis pigmentata Chamberlin, 1919a, p. 7; M.C.Z. no. 2148; California.

Trypanosyllis vittigera Ehlers, 1887, pp. 151–154, pl. 40, figs. 1–3; M.C.Z. no. 843; Florida.

Typosyllis bella Chamberlin, 1919a, p. 7; M.C.Z. no. 2147; California.

NEREIDAE

*?*Ceratonereis articulata* (Ehlers) 1887, pp. 114–116, pl. 36, figs. 1–4; M.C.Z. no. 764; Florida, was first described as a *Nereis*. It is characterized by an absence of paragnaths on the maxillary ring. The teeth of the oral ring were described as pale, obtuse-conical, forming a simple series. The type is tiny, incomplete, proboscis is lacking, and it has been dried at some time. It may be a young stage of another described species.

*[*Nereis bicruciata* Augener] 1906, pp. 151–153, pl. 5, figs. 102–104, pl. 6, fig. 105; M.C.Z. no. 2277; West Indies, is identical with *Nereis nigripes* Ehlers, which is, in turn, the same as *N. riisei* Grube. Augener's type is considerably the smaller of the two. The feet have the typical black patches, distributed as in *N. nigripes* and the parapodial lobes of the two are strikingly similar. The difference in the dentition of the types of Augener and Ehlers, as originally described, is: Area VI of the proboscis has 6 or 7 teeth in a heap in *N. nigripes* and only 4 or 5 in *N. bicruciata*, areas III and IV have fewer teeth in *N. bicruciata*. Both of these differences are not unlikely in specimens of different ages or sizes. More recently Treadwell (1931, p. 14) has described *Nereis decora*, from Brazil. The description agrees with that for *N. riisei* Grube.

Nereis lateseens Chamberlin, 1919a, pp. 10–11; M.C.Z. no. 152: California.

Nereis mediator Chamberlin, 1919a, p. 11; M.C.Z. no. 2153; California.

Nereis mendocinana Chamberlin, 1919b, pp. 256–257, pl. 1, fig. 5; M.C.Z. no. 2129; California, is separable from other species of *Nereis* in its dentition. Areas I, III and V of the proboscis lack teeth, area VI has 7 small cones in a heap on the left side and 6 on the right side. Areas VII and VIII have a single continuous series of 7 larger teeth on the maxillary side and a series of progressively smaller teeth toward the oral side. Jaws have 7 (to 9) quadrate teeth on the cutting edge.

[*Nereis nigripes* Ehlers] 1868, pp. 508–510; M.C.Z. no. 54; Florida, Haiti; is *Nereis riisei* Grube (see Monro, 1933, pp. 43–44, for further synonymy and discussion).

*[*Nereis versipedata* Ehlers] 1887, pp. 116–117, pl. 36, figs. 5–10; M.C.Z. no. 764; Florida, is a *Ceratonereis*, identical with *C. irritabilis* (Webster). I have examined Webster's type in the U.S. National Museum and compared it with the original illustrations. These give an accurate portrayal of the diagnostic parts. The type of *N. versipedata* has numerous paragnaths on area III (unpaired) contrary to the condition illustrated. It is thus as found in *C. irritabilis*.

Nereis procera Ehlers, 1868, pp. 557–559, pl. 23, fig. 2; M.C.Z. no. 155; Gulf of Georgia, has numerous tiny paragnaths on both oral and maxillary rings of the proboscis. In the posteriormost parapodia the dorsal lobe is flattened, equitriangular, the dorsal cirrus attached near its proximal base and extends distally beyond the dorsal lobe. Middle and ventral parapodial lobes are small, digitiform, subequal; the neuroacicular lobe is truncate; ventral cirrus tiny.

Perinereis floridana (Ehlers) 1868, pp. 503–506; M.C.Z. no. 119; Florida, has been redescribed by Langerhans (1879, pp. 280–290) and others.

Uncinereis agassizi (Ehlers) 1868, pp. 542–546, pl. 23, fig. 1; M.C.Z. no. 179; California, includes *Nereis notomacula* Treadwell (1914, pp. 191–192, pl. 11, figs. 8–12; California), *Uncinereis subita* Chamberlin (1919c, pp. 215–219, pl. 30, figs. 1–4; California) and *Platynereis kobiensis* McIntosh (1885, pp. 210–212, pl. 34, figs. 3–6, pl. 16a, figs. 2–4; Japan).

NEPHTYIDAE

(*Nephtys* Cuvier is used instead of the more widely used *Nephthys* Savigny because the former has priority. See Hartman, 1938b, p. 145).

Nephtys bucera Ehlers, 1868, pp. 617–619, pl. 23, fig. 8; M.C.Z. no. 209; Massachusetts Bay, consists of over 100 segments. The type is in two pieces, with some segments perhaps missing. It is much like *N. incisa* Malmgren from Europe. The proboscis has 22 rows of papillae, acicular lobes are conical, the recurved cirri are cirriform, the dorsal cirrus smaller than the recurved cirrus. In the posterior part of the body, however, the postsetal lobes of both rami are expanded, foliaceous (pl. 1, fig. 1) instead of reduced as in *N. incisa*.

Nephtys cirrosa Ehlers, 1868, pp. 624–626, pl. 23, figs. 6, 37, 38; M.C.Z. no. 1242; England.

Nephtys discors Ehlers, 1868, pp. 626–629, pl. 23, figs. 39–40; M.C.Z. nos. 127, 700; Maine, has dorsal and ventral postsetal lobes large, foliaceous throughout, but largest in the anterior region (pl. 1, fig. 3.). Dorsal cirri are short, never as large as the recurved cirri except in the first and last few segments; recurved cirri are first present from the sixth segment as minute papillae; they are fleshy digitiform, slightly recurved where best developed, but never extending much beyond the dorsal half of the foot. Notoacicular lobes are bifid through the anterior half, then gradually become entire (pl. 1, fig. 2).

Nephtys inermis Ehlers, 1887, pp. 125–128, pl. 38, figs. 1–6; M.C.Z. no. 1088; Florida.

Nephtys phyllocirra Ehlers, 1887, pp. 131–134, pl. 38, figs. 7–11; M.C.Z. nos. 62, 1033; Florida.

*[*Nephtys picta* Ehlers] 1868, pp. 632–635, pl. 23, figs. 9, 35; M.C.Z. nos. 246, 830; New England, is close to, if not identical with, *N. caeca* (Fabricius). Recurved cirri are first present at the fourth setigerous segment; acicular and setal lobes agree with those typical of *N. caeca* and the proboscis is proximally covered with coarse, low papillations.

Nephtys squamosa Ehlers, 1887, pp. 128–131, pl. 37, figs. 7–10; M.C.Z. nos. 735, 740, 741, 836; Florida.

GLYCERIDAE

*[*Glycera exigua* Chamberlin] 1919a, pp. 13–14; M.C.Z. no. 2158; California, is identical with *Glycera macrobranchia* Moore (1911, pp. 301–302; California). Chamberlin's type is smaller than is typical of adults of this species, but it agrees in details of structure.

Glycera nana Johnson, 1901, p. 411, pl. 10, figs. 103–103a; M.C.Z. no. 1878; Puget Sound, Washington.

?*Glycera oxycephala* Ehlers, 1887, pp. 121–123, pl. 41, figs. 7–11;

M.C.Z. no. 713; probably West Indies, may be identical with *Glycera gigantea* Quatrefages, from Europe.

Glycera robusta Ehlers, 1868, pp. 656–658, pl. 24, figs. 31, 32; M.C.Z. no. 193; California.

Glycera rugosa Johnson, 1901, pp. 409–411, pl. 10, figs. 101–102; M.C.Z. no. 2296; Puget Sound, is nearly related to *Gl. americana* Leidy, from the east coast of North America. The two may differ slightly in the shape of the setal lobes. *Glycera corrugata* Baird (1863, p. 109; Vancouver) may be identical. Its type, if still extant, should be reinvestigated. *Glycera peruviana* Quatrefages (1865, p. 177) from Peru, is another nearly related form.

GONIADIDAE

Goniada cremita var. *quinquelabiata* Augener, 1906, p. 158; M.C.Z. no. 2297; West Indies, is represented in the collections by a single specimen. Though not designated type, the locality is as stated in the original description.

EUNICIDAE

Eunice collini Augener, 1906, pp. 133–135, pl. 4, figs. 66–73; M.C.Z. no. 2011; West Indies.

Eunice floridana (Pourtales) 1869, p. 108; M.C.Z. nos. 665, 666, 671–675; Florida, has been redescribed and illustrated by Ehlers, 1887, pp. 88–90, pl. 22, figs. 1–7.

[*Eunice fucata* Ehlers] 1887, pp. 91–93, pl. 25, figs. 8–20; M.C.Z. nos. 124, 151, 198, 242, 724; Florida, is identical with *E. schemacephala* Schmarda (see Augener, 1925, p. 28).

[*Eunice antillensis* Ehlers] 1887, pp. 84–85, pl. 24, figs. 5–7; M.C.Z. nos. 140, 799, 810; Florida, is identical with *Eunice longicirrata* Webster (Monro, 1930, p. 121; 1933, pp. 61–62).

[*Eunice conglomerans* Ehlers] 1887, pp. 93–95, pl. 23, figs. 1–9, pl. 24, figs. 1–4; M.C.Z. no. 826; Florida, is identical with *Eunice filamentosa* Grube (see Augener, 1925, p. 9).

Eunice tibiana (Pourtalès) 1869, pp. 108–109; M.C.Z. nos. 719, 743, 745; West Indies; is redescribed by Ehlers, 1887, pp. 90–91, pl. 27, figs. 1–13.

[*Eunice violacco-maculata* Ehlers] 1887, pp. 86–87, pl. 24, figs. 11, 12, pl. 25, figs. 1–7; M.C.Z. nos. 130, 163, 657; Florida, is considered identical with *Eunice rousseaui* Quatrefages (see Fauvel, 1923, p. 403).

*[*Eunice valens* Chamberlin] 1919b, pp. 257–258, pl. 1, figs. 6–8; M.C.Z. nos. 120, 121; California. This was incorrectly included under *E. biannulata* Moore (see Hartman 1938a, p. 96). The latter was therein designated *E. longicirrata* var. *Eunice valens* and *E. biannulata* differ in parapodial and setal structures.

[*Lysidice notata* Ehlers] 1887, pp. 100–102, pl. 30, figs. 1–9; M.C.Z. nos. 711, 794; Florida, was placed in synonymy with *L. brachycera* Schmarda by Augener (1925, p. 29) who considers both the same as *L. ninetta* Audouin and Edwards.

Nicidion brevis Ehlers, 1887, pp. 98–99, pl. 28, figs. 9–14; pl. 29, figs. 1, 2; M.C.Z. no. 833; Florida.

Paramarphysa longula Ehlers, 1887, pp. 99–100, pl. 29, figs. 3–12; M.C.Z. no. 879; Havana.

Rhamphobrachium agassizi Ehlers, 1887, pp. 70–73, pl. 17, figs. 1–5, pl. 18, figs. 1–9; M.C.Z. nos. 754, 779, 788, 789; Florida.

ONUPHIDAE

Diopatra pourtalesii Ehlers, 1879, p. 273; M.C.Z. nos. 687, 785, 815, 874; Florida, was redescribed by Ehlers, 1887, pp. 74–75, pl. 19, figs. 6–10; pl. 20, figs. 1–6.

Nothria elegans Johnson, 1901, pp. 406–407, pl. 8, figs. 77–85; M.C.Z. no. 1895; Washington.

Nothria iridescens Johnson, 1901, p. 408, pl. 8, figs. 86, 87, pl. 9, figs. 88–92; M.C.Z. no. 1887; British Columbia.

Paradiopatra fragosa Ehlers, 1887, pp. 75–76, pl. 20, figs. 7–14, pl. 21, figs. 1–4; M.C.Z. nos. 656, 687, 785, 815, 874; Florida.

Paradiopatra glutinatrix Ehlers, 1887, pp. 76–78, pl. 18, figs. 10–15; pl. 19, figs. 1–5; M.C.Z. nos. 2337–2351; Florida.

Paronuphis gracilis Ehlers, 1887, pp. 78–82, pl. 21, figs. 5–13; Florida.

LUMBRINERIDAE

?**Aracoda debilis* Ehlers, 1887, p. 113, pl. 35, figs. 5–8; M.C.Z. no. 757; Florida, is a *Drilonereis*. Parapodia are provided with stout acicular setae and jaw pieces have attenuated carriers. The forceps (maxillae I) have a few teeth on their inner, basal margin. This species may be identical with *Drilonereis filum* Claparède, reported from both sides of the Atlantic and Pacific oceans.

[*Arabella mimetica* Chamberlin] 1919a, pp. 12–13; M.C.Z. no. 2156; California, is identical with *Arabella iricolor* (Montagu) (see Berkeley, 1932, p. 313).

[*Arabella multidentata* Ehlers] 1887, pp. 112–113, pl. 34, figs. 8, 9, pl. 35, figs. 1–4; M.C.Z. no. 825; Florida, is identical with *Arabella iricolor* (Montagu) (see Fauvel, 1923, p. 438).

*[*Arabella munda* Chamberlin] 1919b, pp. 258–259; M.C.Z. no. 211; California, is identical with *Arabella semimaculata* Moore, 1911, pp. 295–297, pl. 20, figs. 143–149. A characteristic feature is the fleshy, digitate, obliquely directed parapodial lobe.

Biborin ecbola Chamberlin, 1919a, p. 13; M.C.Z. 2157; California.

Lumbrineris bidens Ehlers, 1887, pp. 103–104, pl. 31, figs. 7–17; M.C.Z. nos. 750, 756, 760; Florida.

*[*Lumbrineris floridana* Ehlers] 1887, p. 103, pl. 30, figs. 10–15; M.C.Z. nos. 838, 841; Florida, is identical with *Lumbrineris latreilli* Audouin and M. Edwards. The prostomium is broadly rounded in front (sugar-loaf shaped), not conical as shown by Fauvel (1923, fig. 171 m).

Lumbrineris robusta Ehlers, 1887, pp. 104–105, pl. 31, figs. 1–6; M.C.Z. nos. 742, 747; Florida and Havana.

*[*Lumbrineris zonata* Johnson] 1901, pp. 408–409, pl. 9, figs. 93–100; M.C.Z. no 1954; Puget Sound, is probably identical with *Lumbrineris sarsi* Kinberg. The identity of this common eastern Pacific species with *L. impatiens* Claparede seems likely. Kinberg's type is from Ecuador. I have compared specimens from Alaska south to Lower California and believe them all the same. Specimens are commonly encountered in sand under rocks in the intertidal zone, and in root masses of eel grasses.

Ninoë kinbergi Ehlers, 1887, pp. 105–106, pl. 32, figs. 1–9; M.C.Z. no. 881; Florida.

STAURONEREIDAE

Stauronereis gregarieus Mayer, 1900, pp. 1–14, pl. 1–3; M.C.Z. nos. 1797, 1798; Florida.

[*Stauronereis gregarieus* Mayer], 1900, pp. 1–14, pl. 1–3; M.C.Z. nos. 1797, 1798; Florida, was later identified with *Eunice fucata* Ehlers, by Mayer, 1902. The latter, however, has been shown to be *Eunice schemacephala* Schmarda (see Augener, 1925, p. 29).

ORBINIIDAE

Nainereis hespera Chamberlin, 1919a, pp. 14–15; M.C.Z. no. 2161; California, differs from *Nainereis laevigata* (Grube) in having black parapodial patches and branchiae from the thirteenth or fourteenth segments.

Nainereis nannobranchia Chamberlin, 1919b, pp. 260–261, pl. 2, fig. 10, pl. 3, fig. 1; M.C.Z. no. 2136; California, differs from *Nainereis laevigata* (Grube) in having no branchiae on the anterior thirty segments. Also, the branchiae are short where best developed, hardly meeting in the mid-dorsal line. Both this and *N. hespera* may prove to be only variations and color varieties of *N. laevigata* Grube, which is a common species in the northeast Pacific.

**Scoloplos acmeceps* Chamberlin, 1919a, pp. 15–16; M.C.Z. no. 2162; California, is identical with *Scoloplos elongata* Johnson (1901, pp. 412–413, pl. 10, figs. 105–110; Puget Sound). The latter name is preoccupied by Quatrefages, 1865, hence Chamberlin's name replaces it. A typical parapodium (30th) is shown in pl. 1, fig. 4.

SPIONIDAE

Anaspio boreus Chamberlin, 1920, p. 18, pl. 4, figs. 2–4; M.C.Z. no. 2523; Alaska.

Scolecolepides arcticus Chamberlin, 1920, pp. 17–18, pl. 3, figs. 5–7, pl. 4, fig. 1; M.C.Z. paratypes 2194, 2195; Alaska.

*[*Spio minus* Chamberlin] 1920, p. 16, pl. 3, figs. 1–4; M.C.Z. paratype 2522; Alaska, may be identical with *Spio filicornis* (Müller). The latter has been reported from both north Atlantic and north Pacific waters (Berkeley, 1936, p. 475). Chamberlin separated *S. mimus* on differences observed in posterior parapodia and in the distribution of crotchets. The variations, however, appear to fall within the range found in *S. filicornis*.

CIRRATULIDAE

*[*Cirratulus cingulatus* Johnson] 1901, pp. 422–423, pl. 14, figs. 145–148; M.C.Z. no. 1906; Washington, agrees with descriptions of *C. cirratus* (Müller). The prostomium has paired series of eye spots, setae and parapodial arrangements are as typical for *C. cirratus*.

Cirratulus exuberans Chamberlin, 1919b, pp. 263–264; M.C.Z. no. 1285; Panama.

Cirratulus robustus Johnson, 1901, p. 423, pl. 14, figs. 149, 150; M.C.Z. no. 1882; Puget Sound, Washington.

FLABELLIGERIDAE

?*Flabelligera haerens* Chamberlin, 1919a, p. 16; M.C.Z. no. 2163; California, is represented by a single, small individual (13 mm. long). It may be a young specimen of *Flabelligera affinis* Sars, as Monro has suggested (1933, p. 4).

Flabelligera infundibularis Johnson, 1901, p. 417, pl. 12, figs. 124–127; M.C.Z. nos. 2503, 2508; Puget Sound, differs from *H. affinis* Sars in the distribution of its composite setae and the nature of its sensory papillae.

Stylarioides collarifer Ehlers, 1887, pp. 161–164, pl. 43, figs. 2–7, M.C.Z. nos. 775, 778, 784; Florida.

Stylarioides papillata Johnson, 1901, p. 416, pl. 12, figs. 122, 123; M.C.Z. no. 1900; Washington, is close to, if not identical with, *S. plumosa* (O. F. Müller). Monro (1933b, p. 1058), has already pointed out this similarity.

SCALIBREGMIDAE

Kebuita glabra (Ehlers) 1887, pp. 169–172, pl. 45, figs. 1–4; M.C.Z. no. 695; Havana, originally described as a *Eumenia*, was made the type of the genus *Kebuita* Chamberlin (1919c, p. 390). It agrees in its details with the description of *Oncoscolex heterochaetus* Augener (1906, pp. 159–161, pl. 6, figs. 110–112) for which Chamberlin erected the genus *Gwasitoa* (1919c, p. 390). The first three segments in the type are slightly set off from the rest of the body by having more conspicuous parapodia, provided with sickle-shaped setae (as illustrated by Augener). The dorsal surface of *E. glabra* is somewhat corrugated as described by Augener. Forked setae were not observed in *O. heterochactus*, but Augener suggested the likelihood that they had been broken off or lost. Both have an anal funnel terminating in a crenulate collar.

Augener has already pointed out the possibility that these two names refer to the same species (1906, p. 161). Because of the similarity of Ehlers' type with Augener's description, and the proximity of type localities (Havana, 175 fms. and St. Vincent, 424 and 785 fms. respectively) the two are considered identical. *Gwasitoa* Chamberlin thus becomes a synonym of *Kebuita* Chamberlin. A revised diagnosis of *Kebuita* follows.

Body maggot-like; prostomium with lateral processes (frontal horns); no eye spots or visible nuchal organs. Parapodia biramous, the

rami well separated from each other, but poorly developed, most conspicuous in the anterior region, the first three setigerous segments slightly set off from those more posteriorly by their more prominent feet. Setae of first three setigerous segments sickle-shaped; setae in more posterior parapodia capillary and forked. Dorsal and ventral cirri absent. Anal funnel cylindrical, terminating posteriorly in a crenulate collar with short papillae on the ventral edge but without anal cirri.

Remarks. Differs from *Asclerocheilus* Ashworth in lacking anal cirri and in having an anal funnel; differs from *Oncoscolex* Schmarda (which may be identical with *Hyboscolex* Schmarda, according to Augener, 1923, p. 83) in lacking eye spots, in having parapodia much more reduced, in having an anal funnel without cirri.

The type of the genus is *Eumenia glabra* Ehlers.

CAPITELLIDAE

Dasybranchus lumulatus Ehlers, 1887, pp. 174–177, pl. 45, figs. 5–9; M.C.Z. no. 847; Florida.

Notomastus angulatus Chamberlin, 1919a, pp. 16–17; M.C.Z. no. 2164; California.

MALDANIDAE

Clymene cingulata Ehlers, 1887, pp. 185–188, pl. 47, figs. 2–5; M.C.Z. no. 541; Florida, was made the type of *Clymenopsis* Verrill (1900, p. 654). It is known through a single anterior end, characterized as follows: Head plaque reduced to a thickened area bearing a pair of parallel nuchal organs; fourth segment with a ventrally produced collarette; stout acicular spines on first three segments; uncini in single rows.

Clymene cirrata Ehlers, 1887, pp. 182–185, pl. 46, figs. 10–13; M.C.Z. no. 2402; Florida, has been dried and is considerably fragmented. Arwidsson (1907, p. 145) has shown that it is a *Leiochone.*

Maldane collariceps Augener, 1906, pp. 163–167, pl. 6, figs. 114–120; M.C.Z. 2029; West Indies, is an *Asychis.* Its affinities with *A. biceps* (Sars) and *A. coronata* (Moore) have been discussed by Angener.

Maldane cuculligera Ehlers, 1887, pp. 178–182, pl. 46, figs. 1–9; M.C.Z. no. 771; Florida.

Nicomache personata Johnson, 1901, pp. 419–420, pl. 13, figs. 134–139; M.C.Z. no. 1918; Washington.

Nichomachella (?) *picta* Ehlers, 1887, pp. 192–193, pl. 47, fig. 1; M.C.Z. no. 241; Florida, is a *Praxillura* Verrill (Arwidsson, 1907, p. 26).

OWENIIDAE

[*Ammocharcs occidentale* Johnson] 1901, pp. 420–421, pl. 14, figs. 140–142; M.C.Z. no. 1997; Washington; is identical with *Owenia fusiformis* (delle Chiaje) (see Berkeley, 1930, p. 67).

SABELLARIIDAE

[*Idanthyrsus ornamentatus* Chamberlin] 1919b, pp. 262–263, pl. 3, figs. 2–5; M.C.Z. no. 156; California, is identical with *Idanthyrsus johnstoni* (McIntosh) (see Berkeley, 1930, p. 74).

Lygdamis asteriformis (Augener) 1906, pp. 167–171, pl. 7, figs. 129–138; M.C.Z. nos. 2053, 2054; West Indies (see Johansson, 1927, p. 86).

Sabellaria nanella Chamberlin, 1919b, pp. 261–262, pl. 2, figs. 5–7; M.C.Z. paratype no. 482; California, differs from other described species in its opercular spines. Those of the outer, middle and inner sets are illustrated in pl. 3, figs. 10, 8 and 9 respectively.

PECTINARIIDAE

Pectinaria (*Petta*) *pellucida* Ehlers, 1887, pp. 194–199, pl. 44, figs. 1–9; M.C.Z. no. 2559; Florida, is represented by a unique specimen not designated type, but presumably labelled in Ehlers' handwriting, and collected from 270 fms. in the Santaren Channel.

AMPHARETIDAE

Ampharete reducta Chamberlin, 1920, p. 24, pl. 5, figs. 4, 5; M.C.Z. paratype no. 2192; Alaska.

Amphicteis nasuta Ehlers, 1887, pp. 232–236, pl. 49, figs. 1–6; M.C.Z. no. 755; Florida, has been assigned to *Anobothrus* (see also Hessle, 1917, p. 107).

Amphicteis procera Ehlers, 1887, pp. 226–232, pl. 48, figs. 1–9; M.C.Z. no. 852; Florida.

Auchenoplax crinita Ehlers, 1887, pp. 209–214, pl. 44, figs. 10–16; M.C.Z. nos. 850, 873; Florida.

Melinna monocera Augener, 1906, pp. 177–180, pl. 6, figs. 121–125; M.C.Z. no. 2128; West Indies.

Melinna parumdentata Ehlers, 1887, pp. 214–220, pl. 50, figs. 1–9; M.C.Z. no. 872; Florida.

Sabellides anops Johnson, 1901, pp. 424–425, pl. 15, figs. 157–161, pl. 16, figs. 162, 163; M.C.Z. no. 1892; Washington (?) is an *Amage*. Berkeley (1929, p. 311) considers it likely that this is the same as *A. auricula* Malmgren, known from the boreal Atlantic and Pacific.

Schistocomus hiltoni Chamberlin, 1919a, pp. 17–18; M.C.Z. no. 2166; California.

TEREBELLIDAE

Amphitrite robusta Johnson, 1901, pp. 425–426, pl. 16, figs. 164–168; M.C.Z. nos. 954, 2392; Puget Sound, has been assigned to *Neoamphitrite* Hessle (1917, p. 184).

Amphitrite spiralis Johnson, 1901, pp. 426–427, pl. 16, figs. 169–171; M.C.Z. no. 1874; Washington, is a *Neoleprea* Hessle (1917, p. 193).

Terebella bruneo-comata Ehlers, 1887, pp. 237–241, pl. 51, figs. 1–5; M.C.Z. no. 831; Florida, was made the type of the subgenus *Amphitrides* Augener (1922, p. 47). Monro (1933, p. 1071) has reported it from the Galapagos Islands and consideres *Terebella panamena* Chamberlin, from Panama, identical.

Eupolymnia crescentis Chamberlin, 1919b, pp. 265–266, pl. 3, figs. 6, 7; M.C.Z. no. 2135; California, is distinct from *E. nebulosa* (Montagu). The ventral thoracic plates, save those of the first three segments which are broadly rectangular, are broad, trapezoidal, with the anterior, longer side slightly arcuate. The scutes are broadest in the regions of the seventh to ninth segments, here they are about five times as broad as long. They become rapidly smaller from the twelfth setigerous segment, the fifteenth is tiny, the last two thoracic segments lack scutes. The cephalic lobe has numerous minute eye spots, but the lobe is not conspicuously elongate as in *E. nebulosa*. Thoracic uncinigerous tori are proportionately longer and extend into the angle formed by the lateral extensions of the thoracic plates. Thoracic uncini have a more elongate base, with tooth nearer the base of the hook (see Chamberlin, 1919b, pl. 3, figs. 6, 7).

Leaena videns Chamberlin, 1919a, p. 18; M.C.Z. no. 2167; California.

Nancva hespera Chamberlin, 1919a, p. 19; M.C.Z. no. 2169; California.

Pista brevibranchia Chamberlin, 1919b, pp. 264–265; pl. 2, figs. 1–4; M.C.Z. no. 502; California, is characterized by having the lateral thoracic lappets continued through 5–7 anterior segments (see also Moore, 1923, p. 196). Chamberlin's name is pre-occupied by Caullery (1915, p. 76). The name *P. brevibranchiata,* apparently inadvertently used by Moore (1923, p. 196) is suggested to replace *P. brevibranchia* Chamberlin.

Pista fratrella Chamberlin, 1919a, pp. 18–19; M.C.Z. no. 2168; California.

Scionides dux Chamberlin, 1919b, pp. 206–207, pl. 3, fig. 9; M.C.Z. no. 2134; California.

Terebella ectrata Ehlers, 1887, pp. 248–253, pl. 52, figs. 9–14; M.C.Z. no. 834; Florida, is a *Pista* (see Hessle, 1917, p. 163).

Terebella reticulata Ehlers, 1887, pp. 245–248, pl. 52, figs. 5–8; M.C.Z. no. 840; Florida, has been dried and is badly broken. It may be a *Neoamphitrite* (see also Hessle, 1917, p. 184). Thoracic notopodial setae are distally denticulate.

[*Terebella turgidula* Ehlers] 1887, pp. 241–245, pl. 52, figs. 1–4; M.C.Z. no. 846; Florida, is a *Eupolymnia* (see Hessle, 1917, p. 178), identical with *E. crassicornis* (Schmarda) (see Augener, 1925, p. 36).

SABELLIDAE

Bispira polymorpha Johnson, 1901, pp. 428–430, pl. 17, figs. 179–183, pl. 18, figs. 184, 185; M.C.Z. nos. 1901, 1902, 1903, 1941; Puget Sound to Pacific Grove, includes four species, — *Eudistylia polymorpha, E. vancouveri* (Kinberg) and *Schizobranchia* spp. (see p. 26 for discussion).

Branchiomma bioculatum Ehlers, 1887, pp. 260–263, pl. 53, figs. 1–9; M.C.Z. no. 669; Florida, is a *Megalomma* (Johansson, 1927, p. 132). It should be examined in the light of other collections from the type locality.

Branchiomma lobiferum Ehlers, 1887, pp. 254–259, pl. 53, figs. 10–15; M.C.Z. no. 835; Florida, is a *Megalomma* (see Johansson, 1927, p. 132). It has a straight collar, the dorsal lobes are inconspicuous, most of the ventral radioles have terminal eyes, and the branchiae are greatly elongated.

Chone ungavana Chamberlin, 1920, pp. 26–27, pl. 6, figs. 1–4; M.C.Z. paratype no. 2550; Alaska.

[*Dasychone conspersa* Ehlers] 1887, pp. 266–270, pl. 54, figs. 1–6;

M.C.Z. no. 848; Florida, is identical with *Branchiomma nigromaculata* (Baird) (see Johansson, 1927, pp. 162–163).

[*Distylia monterca* Chamberlin] 1919b, pp. 267–268; M.C.Z. no. 1941, is identical with *Eudistylia polymorpha*, see p. 26 for discussion.

Hypsicomus circumspiciens Ehlers, 1887, pp. 271–277, pl. 55; figs. 5–13, pl. 56, figs. 1–3; M.C.Z. no. 662; Florida, was made the type of the genus *Hypsicomatopsis* Augener. It is likely that *Protulides elegans* Webster (1884, pp. 325–326, pl. 11, figs. 63–74; Bermuda) is the same as *H. circumspiciens*.

Megachone aurantiaca Johnson, 1901, pp. 430–431, pl. 18, figs. 186–192; M.C.Z. no. 1933; Washington.

*[*Myxicola monacis* Chamberlin] 1919a, p. 20; California, is identical with *Myxicola infundibulum* (Renier), see discussion under *M. pacifica*.

*[*Myxicola pacifica* Johnson] 1901, pp. 431–432, pl. 19, figs. 193–198; M.C.Z. nos. 1879, 1893; Washington, is identical with *M. infundibulum* (Renier). This species is known from both north Atlantic and Pacific oceans. Individuals from British Columbia south to southern California, agree in important details with descriptions given for Atlantic species. Characteristic features of a specimen from California, are shown in pl. 1, figs. 5-11, pl. 2, fig. 1.

Potamethus spathiferus (Ehlers) 1887, pp. 278–283, pl. 54, figs. 7–11, pl. 55, figs. 1–4; M.C.Z. no. 800; Florida.

*[*Potamilla clara* Chamberlin] 1919a, p. 20; M.C.Z. no. 2171; California, is a *Megalomma*, and has affinities with *M. roulei* (Gravier). *M. clara* has one pair of dark, compound terminal eyes; the thoracic collar lacks dorsal lappets.

*[*Potamilla colorata* Chamberlin] 1919a, p. 21; M.C.Z. no. 2173; California, is identical with *Megalomma clara* (see above). Two of the radioles have dark, compound eyes. Collar lacks dorsal lappets.

*[*Pseudopotamilla lampra* Chamberlin] 1919a, p. 22; M.C.Z. no. 2176; California, is identical with *Pseudopotamilla occelata* Moore, see p. 506 for discussion.

*[*Pseudopotamilla macrops* Chamberlin] 1919a, p. 22; M.C.Z. no. 2177; California, is identical with *Pseudopotamilla intermedia* Moore, see p. 506 for discussion.

*[*Pseudopotamilla panamaica* Chamberlin] 1919b, pp. 268–269, pl. 3, fig. 8; M.C.Z. no. 72; Panama, is a *Megalomma*, identical with *M. vesiculosum* (Montagu) cosmopolitan. Terminal eyes are numerous; dorsal collar lappets are long, foliaceous; lateral collar lobes are conspicuous.

*[*Pseudopotamilla parva* Chamberlin] 1919a, p. 21; M.C.Z. no. 2175;

California, is doubtfully referred to *Megalomma*. The type resembles *P. elara*, except that terminal eyes cannot be made out. Only a few anterior segments are present. Dorsal collar lobes are greatly reduced.

*[*Pseudopotamilla paurops* Chamberlin] 1919a, p. 21; M.C.Z. no. 2174; California, is identical with *P. occelata* Moore. See p. 507 for discussion.

*[*Pseudopotamilla scotia* Chamberlin] 1919a, p. 22; M.C.Z. no. 2178; California, is identical with *P. occelata* Moore. See p. 507 for discussion.

SERPULIDAE

Crucigera hespera Chamberlin, 1919b, p. 270, pl. 2, fig. 9; M.C.Z. no. 164; California.

Crucigera zygophora (Johnson) 1901, pp. 433–434, pl. 19, figs. 205–208; M.C.Z. no. 1875; Washington, has been subsequently treated by Bush (1904, p. 233).

?*Eupomatus intercans* Chamberlin, 1919a, p. 23; M.C.Z. no. 2178; California, is probably identical with *Eupomatus uncinatus* Philippi, as already suggested by Chamberlin. The unique type has been dried.

Filograna huxleyi Ehlers, 1887, pp. 314–320, pl. 56, figs. 4–8; M.C.Z. no. 739; Florida.

Hyalopomatus langerhansi Ehlers, 1887, pp. 304–307, pl. 60, figs. 10–15; M.C.Z. nos. 688, 759; Havana.

Placostegus incomptus Ehlers, 1887, pp. 300-304, pl. 60, figs. 1, 2; M.C.Z. no. 811; Havana.

Protula antennata Ehlers, 1887, pp. 321–324, pl. 59, figs. 4–9; M.C.Z. no. 808; Florida. The type jar contains several pieces of one specimen and parts of two tubes, the latter presumably belonging to the species. Augener (1925, p. 39) concluded that this may be identical with *P. longiseta* Schmarda (1861, p. 32) from Jamaica. This synonymy seems doubtful, however, for several reasons. The tube of *P. antennata* is externally ridged and not lined with a chitinous layer; the uncini and collar are different. I am unable to add to Ehlers' description of the collar. The unique type has been dried and is broken. A few of the posterior setae are longer than indicated by Ehlers, but none is conspicuously long.

Protula submedia Augener, 1906, pp. 188–191, pl. 7, figs. 145–147, pl. 8, figs. 148–152; M.C.Z. no. 2055–2060; West Indies, may be the same as *P. diomedeae* Benedict (1887, pp. 547–548, pl. 20, figs. 1–6) from Cape Hatteras and the Gulf of Mexico. The latter is incompletely described.

Serpula nannoides Chamberlin, 1919b, p. 270, pl. 2, fig. 8; M.C.Z. no. 511; California.

[*Serpula columbiana* Johnson] 1901, pp. 432–433, pl. 19, figs. 199–204; M.C.Z. no. 1896; Puget Sound to San Francisco, has long been considered identical with *Serpula vermicularis* Linnaeus (see Chamberlin, 1919c, p. 269).

A REVISION OF THE SPECIES OF THE GENUS *EUDISTYLIA* BUSH

Type. Sabella vancouveri Kinberg (1867, p. 353; Vancouver Island).

Diagnosis. Paired branchial lobes equal, their ventral ends free and turned inward, or spirally coiled. The free dorsal ends of the branchial bases produced in a more or less flattened, simple or cleft, stiffened membrane (pl. 2, fig. 5).

Radioles numerous, usually simple, rarely divided, the stem approximately three-sided in cross section but the angles blunt. Pinnae arranged in double series on the inner sides of the radioles as characteristic of the SABELLINAE, without stylodes. Eye spots more or less numerous, rarely absent, arranged in a single or irregular double series on the outer sides of the radioles.

Collarette with dorsolateral notches in addition to the dorsal and ventral clefts. Oral membranes ruffled, thin, wide. Palpi lanceolate or foliaceous. Thorax with dorsal furrow and ventral plates. Thoracic notopodia with winged lanceolate setae and spatulate setae, the latter sharply set off; thoracic neuropodia with avicular uncini accompanied by pennoned setae. Abdomen with dorsal plates divided by a deep-longitudinal furrow. Abdominal parapodia with notopodial avicular uncini and neuropodial winged lanceolate setae.

Remarks. Differs from *Bispira* Kröyer primarily in having spatulate setae instead of the scimitar-like setae in thoracic notopodia.

This genus is known only from the Pacific Ocean. Ten species have been assigned to it. These are listed below. Those considered synonyms are enclosed in brackets.

*[*Eudistylia abbreviata* Bush] 1904, p. 212; Alaska; is identical with *E. vancouveri* (Kinberg). The color was said to have been similar to that of *E. gigantea*, which is also identical with *E. vancouveri*. The collar is deep along the sides, and curves obliquely ventrally; setae and collar agree with those described for *E. vancouveri* (see Johansson, 1926, p. 14).

Eudistylia brevicomata (Ehlers) Augener, 1926, p. 251; New Zealand, may be identical with *Sabella ceratodaula* Schmarda Augener, 1926, p. 253 (see also Johansson, 1927, p. 138). Ehlers described the eye spots as disposed in two irregular rows. I have not seen this condition in any specimens of *Eudistylia* from the north Pacific.

Augener (1926, p. 253) has already discussed the possible identity of *E. brevicomata* Ehlers, *S. ceratodaula* Schmarda and *S. grandis* Baird (1865, p. 160), all from New Zealand. It is likely that the descriptions of Schmarda, Baird, Kinberg and Ehlers were all based on individuals which represent a single, widely distributed species. Such a conclusion cannot be made, however, without study of more collections from the areas in question.

It is of interest that Ehlers had at least one specimen of "*Bispira polymorpha* Johnson" from California, and that he observed no significant differences between his own species and the specimen from Johnson. Unfortunately it is not possible to know whether Johnson had sent him *E. vancouveri* or what is really *E. polymorpha* (see below). Probably it is the former, however, since the color pattern of it agrees with that of *E. brevicomata.* A pencilled note on the back of Johnson's label of M.C.Z. type no. 1941 reads, "1 sp. sent Ehlers Apr. 30, '03." Since it appears unquestionable that Johnson did base his description and illustrations on two species, and since his figure of the anterior portion of the animal (Johnson, 1901, fig. 179) agrees fairly well with the specimen remaining in the type jar, 1941, it is reasonable to assume that he had sent Ehlers the other species, *E. vancouveri* (see discussion under *B. polymorpha,* below).

?*Sabella ceratodaula* Schmarda 1861, from New Zealand, may be the same as *E. brevicomata* (Ehlers) 1905, from the same region. (see Augener, 1926, p. 248).

*[*Eudistylia gigantea* Bush] 1904, p. 210; is identical with *E. vancouveri* (Kinberg). Johansson (1927, p. 135) has already indicated this synonymy. The radioles (according to Bush's description are marked with three conspicuous bands of maroon. The illustrations of Bush (1904, pl. 22, figs. a, c) however, show four bands of pigment. Johansson, on reexamining Kinberg's type of *Sabella vancouveri,* described four or five bands of pigment. In other respects, *S. vancouveri* and *E. gigantea* agree.

*[*Eudistylia intermedia* Bush] 1904, p. 214; California, is questionably referred to *E. polymorpha* (Johnson). Bush separated this species from *E. polymorpha* on the basis that its branchiae are more numerous, the eyes less conspicuous and the avicular uncini shaped somewhat

differently. She may have had specimens of *E. vancouveri* (Kinberg) for comparison. Branchiae were described as being "brown or pinkish purple on the lower portion" with a "narrow, scarcely discernible pink band farther out." This agrees with *E. polymorpha* and not with *E. vancouveri*. The synonymy of *E. intermedia* and *E. polymorpha* is further indicated in that the eyes were "less conspicuous." The eyes of *E. polymorpha* are well marked, but less conspicuous because of the darker color of the radioles.

*[*Distylia monterea* Chamberlin] 1919b, p. 267; M.C.Z. no. 1941; California, belongs to *Eudistylia*, identical with *E. polymorpha*. The type specimen was originally one of Johnson's four types of *Bispira polymorpha*, the other three type jars (M.C.Z. nos. 1901, 1902, 1903) include *E. vancouveri* and two species of *Schizobranchia*. That Johnson partly used type 1941 in his original description is certain, for he mentions the two color phases "purple or wine-color, and whitish or tawny," the former being what Chamberlin subsequently named *D. monterea*, and the latter specimens of *E. vancouveri* (see also discussion under *E. brevicomata* and *E. polymorpha*).

*[*Eudistylia plumosa* Bush] 1904, p. 212; Alaska, is probably identical with *E. vancouveri* (Kinberg). The thoracic avicular uncini resemble those of Kinberg's species. *E. plumosa* is too incompletely known to permit certain identity. Nothing is known of the nature of the collar, the branchial lobes, the radioles, except that the collar has conspicuous ventral ends, and the branchiae are banded with pigment. Both of these characters agree, however, with *E. vancouveri*.

Bispira polymorpha Johnson, 1901, p. 428; M.C.Z. nos. 1901, 1902, 1903, 1941; Puget Sound to Pacific Grove, includes the following:

M.C.Z. no. 1901, from Port Orchard, is a *Schizobranchia*, probably *S. nobilis* Bush.

M.C.Z. no. 1902, from Puget Sound, includes two specimens, *E. vancouveri* (Kinberg) and *Schizobranchia insignis* Bush.

M.C.Z. no. 1903, from Humboldt Bay, is *E. vancouveri* (Kinberg)

M.C.Z. no. 1941, from Pacific Grove, includes a single specimen, hereby retained to represent the holotype of *E. polymorpha* (Johnson).

M.C.Z. no. 1941 was used in the original description, as brought out above, under *D. monterea*. (See also *E. brevicomata*, above).

Question arises as to the status of the names, *Bispira polymorpha* Johnson (1901), *Eudistylia intermedia* Bush (1904) and *Distylia monterea* Chamberlin (1919). The first is clearly based on at least two species of *Eudistylia*, one the older *E. vancouveri* (Kinberg), the other

what was subsequently made the type of *Distylia monterea*. Two procedures present themselves. (1) Reduce *polymorpha* to synonymy with *vancouveri* and retain *monterea* for the specimen M.C.Z. 1941, or (2) retain *polymorpha* for M.C.Z. 1941, reducing *monterea* to synonymy with it. The former procedure would be preferable in some respects were it not for the questionable status of *E. intermedia*. The existence of Bush's type is not known, and its identity with *E. monterea* not certain. Also, it predates Chamberlin's name, hence places *monterea* in the position of a possible synonym. Consequently I am retaining Johnson's type, M.C.Z. 1941, as the holotype of *E. polymorpha* and considering *E. intermedia* and *D. monterea* as synonyms.

?*Eudistylia tenella* Bush, 1904, pp. 213–214; Alaska, resembles *Demonax* in (1) lacking eye spots, (2) having delicate pinnae, (3) the nature of the collar. It may be a specimen of the widely distributed *Demonax leucaspius* Kinberg.

Eudistylia vancouveri (Kinberg) 1865, p. 353; Vancouver Island, was redescribed by Johansson (1926, p. 13; 1927, p. 135) who had access to the type. It probably includes *E. abbreviata* Bush, *E. gigantea* Bush, *E. plumosa* Bush, and *E. polymorpha*, in part. Radioles have five to eight transverse pigment bands of alternating tawny and maroon. Each eye spot usually has an oblique splash of color. Collar has high dorsal lobes (pl. 2, fig. 2), deep dorsolateral clefts, oblique lateral lobes and broadly triangular ends (pl. 2, figs. 3 and 4). Dorsal branchial base is simple, not cleft (pl. 2, fig. 2). Dorsal oral membrane is provided with medial and lateral finger-like elongations (pl. 3, fig. 7).

Key to the accepted species of Eudistylia

1. Branchial eye spots disposed in double rows . . . . . *E. brevicomata*
1. Branchial eye spots in single rows 2
2. Dorsal side of branchial membrane deeply cleft, the two lobes thus formed broadly overlapping (pl. 2, fig. 5); branchiae deep maroon except for a short band distally; ventral collar lobes not greatly produced and not oblique. . . . . *E. polymorpha*
2. Dorsal side of branchial membrane with rectangular flaps, not cleft (pl. 2, fig. 2); branchiae with numerous transverse bands of maroon and flesh-colored (preserved); ventral lobes of collar produced, oblique. *E. vancouveri*

A REVISION OF THE SPECIES OF THE GENUS *PSEUDOPOTAMILLA* BUSH

Type. Amphitrite reniformis Montagu.

Diagnosis. Paired branchial lobes equal, circular, not spiralled. The free dorsal ends of the branchial bases produced in a flattened, simple or cleft, membrane (pl. 2, fig. 8). Radioles numerous, simple, not divided; pinnae arranged in double series as characteristic of the SABELLINAE, without stylodes. Eye spots in single rows, disposed on the outer, lateral borders of the radioles.

Collarette with dorsal and ventral clefts, and dorsolateral incisions; otherwise as in *Potamilla* Malmgren. Thoracic setae consist of lanceolate and spatulate setae in notopodia, and avicular hooks with companion pennoned setae in neuropodia. Abdominal setae include avicular hooks in the notopodia and lanceolate setae in neuropodia.

The species that have been assigned to *Pseudopotamilla*, and those assigned to other genera but which are of this genus, are listed below. Synonyms are enclosed in brackets. New synonyms are preceded by an asterisk.

[**Pseudopotamilla anoculata* Moore] 1905, pp. 564–566, pl. 37, figs. 23–27; Alaska, is a *Megalomma*, identical with *M. splendida* (Moore) new comb.

*[*Pseudopotamilla brevibranchiata* Moore] 1905, pp. 555–559, pl. 37, figs. 1–7; Alaska, is identical with *Ps. occelata*. These two were first separated on the observation that the latter was longer, had more elongated branchiae, more conspicuous branchial eyes, and because of slight differences in the shapes of the avicular setae. Subsequent records of both species (Moore, Chamberlin, etc.) have shown that the branchiae are usually longer than first recorded for *Ps. brevibranchiata* and shorter than for *Ps. occelata*, and that the differences first noted, vary within wide ranges. Branchial eye spots vary, both as to size and number (see also Chamberlin, 1918, p. 179; Berkeley, 1930, p. 70).

?*Pseudopotamilla debilis* Bush, 1904, p. 204, pl. 36, figs. 23, 24, 26; California, cannot be identified with certainty. It may be either *Ps. occelata* Moore, or *Ps. intermedia* Moore.

[*Pseudopotamilla debilis* Moore] 1908, p. 360; Gulf of Georgia, deposited in the U.S. National Museum, is a specimen of *Megalomma splendida* (Moore) (see below).

Pseudopotamilla intermedia Moore, 1905, pp. 562–564, pl. 37, figs. 15–22; Alaska, probably includes *Ps. reniformis* Moore (1908, p. 359;

Alaska, Berkeley, 1930, p. 70; British Columbia) and also *Ps. macrops* Chamberlin (1919a, p. 22; California). Characteristic features of this species are: (1) The dorsal branchial membrane is a narrow, rectangular flap, hardly overlapping (pl. 2, fig. 8); (2) the dorsalmost radiole has a slender tentacle, set some distance from the base of the pinnae (pl. 3, fig. 1); (3) the uncini in the last two or three thoracic segments are large, long-handled, in contrast to the smaller ones in more anterior segments (cf. pl. 3, figs. 4 and 5); (4) the dorsal collar lobes are free lappets, concealing the peristomium (pl. 2, fig. 8). Spatulate setae have a slender mucron (pl. 3, fig. 3).

*[*Pseudopotamilla lampra* Chamberlin] 1919a, p. 22, is identical with *Ps. occelata* Moore. The cleft dorsal branchial membrane, collar, thoracic structures and branchiae are like those in *Ps. occelata.*

*[*Pseudopotamilla macrops* Chamberlin] 1919a, p. 22, is identical with *Ps. intermedia* Moore. The type (M.C.Z. no. 177) is unique, consists of only head and three setigerous segments. The dorsal edge of the branchial membrane is a narrow, entire flap; radioles have few eye spots, there are three on the left side, one on the right side; dorsal lobes of the collar are almost as high as the lateral lobes; the collar is as described for *Ps. intermedia.* The nature of the posterior thoracic segments cannot be ascertained.

Pseudopotamilla occelata Moore, 1905, pp. 559–562, pl. 37, figs. 8–14; Vancouver Island, is a widely distributed species in the northeast Pacific. It includes the following species, *Ps. brevibranchiata* Moore, *Ps. brevibranchia* Chamberlin, *Ps. lampra* Chamberlin, *Ps. paurops* Chamberlin, *Laonome oculifera* Treadwell, and probably *Ps. scotia* Chamberlin. Characteristic features of this species are:

The branchial membrane has notched wings dorsally (pl. 2, fig. 6), dorsal lobes of the collar are low, exposing much of the peristomium; lateral lobes of the collar rise abruptly anterior to the collar fascicle; the lateral lobes are set off from the ventral lobes by a slight notch, the ventral lobes are continued along their ventralmost margins into two elongated lobes. Branchial eyes are black, conspicuous, rounded, or often with a faint short splash; ventral thoracic plates are rectangular, except the first which is shield-shaped (pl. 2, fig. 7).

Remarks. This species occurs commonly in the littoral zone, from Alaska south to southern California. It is often in clusters of tubes or colonies.

*[*Pseudopotamilla panamaica* Chamberlin] 1919b, p. 268; Panama, is a *Megalomma,* identical with *M. vesiculosum* (Montagu) cosmopolitan.

*[*Pseudopotamilla parva* Chamberlin] 1919a, p. 21, is doubtfully referred to *Megalomma* (see also p. 499).

*[*Pseudopotamilla paurops* Chamberlin] 1919a, p. 21; California, is identical with *Pseudopotamilla occelata*. The type is much like that of *P. lampra*.

Pseudopotamilla reniformis (Montagu) is a widely distributed, warm water species. Such records as have been reported from the northeast Pacific must be doubted, in view of the possible confusion of this species with *P. intermedia* Moore.

*[*Pseudopotamilla scotia* Chamberlin] 1919a, p. 22; California, is doubtfully referred to *P. occelata* Moore. The type has been dried and is incomplete. It consists of the head and eight setigerous segments. The radioles are greatly shrunken and have lost much of the epithelial layer. The specimen agrees with *P. occelata* in having a notched dorsal branchial membrane, the dorsal collar lobes are low, the collar is straight, and the ventral tips are elongated.

*[*Pseudopotamilla splendida* Moore] 1905, pp. 564, pl. 37, figs. 23–27; Alaska, is *Megalomma splendida*, new comb. Its terminal eyes are spiralled as in *Branchiomma burrardum* Berkeley (1930, p. 71). There are other reasons for regarding the two synonymous, as is patent in comparing the descriptions of the two. *Ps. anoculata* Moore is also identical with *M. splendida*, as has been verified by examining the types in the U.S. National Museum.

*[*Laonome oculifera* Treadwell] 1914, pp. 222–223, pl. 12, figs. 39–43; California, is a *Pseudopotamilla*, identical with *Ps. occelata* Moore. Its type has been examined in the collections of the University of California, and found to agree with Moore's species.

Sabella (*Potamilla*) *oligophthalmos* Grube from the Philippines, is a *Pseudopotamilla* (see Augener, 1926, p. 253). It includes *Potamilla lacinosa* Ehlers, 1905, from New Zealand (see Augener,— 1926).

[*Potamilla lacinosa* Ehlers] 1905, pp. 66–67, pl. 9, figs. 7–10; from New Zealand, is considered identical with *P. oligophthalmos* (Grube) from Singapore (see Augener, 1926, p. 253).

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EXPLANATION OF PLATES

PLATE 1

PLATE 1.

Fig. 1. *Nephtys bucera* Ehlers. Foot from eleventh posteriomost segment, in anterior view, x 22.

Fig. 2. *Nephtys discors* Ehlers. Foot from posterior fourth of body, in anterior view, x 12.

Fig. 3. Same. Foot from anterior fourth of body, in anterior view, x 12.

Fig. 4. *Scoloplos acmeceps* Chamberlin. Parapodium from thirtieth segment, x 35.

Fig. 5. *Myxicola infundibulum* (Renier). Anterior end in ventral view, of specimen from California, x 11.

Fig. 6. Same. Anal region, showing distribution of pigmented spots, x 11.

Fig. 7. Same. Anterior end in dorsal view, first setal fascicle indicated, x 11.

Fig. 8. Same. Larger abdominal uncinus, x 700.

Fig. 9. Same. Smaller abdominal uncinus from same foot as that in fig. 8, and alternating with it, x 700.

Fig. 10. Same. Anterior end in lateral view, setae omitted, x 11.

Fig. 11. Same. Four anterior abdominal segments in lateral view, showing distribution of uncini (smaller dots) and ocular points with respect to setal fascicles, x 11.

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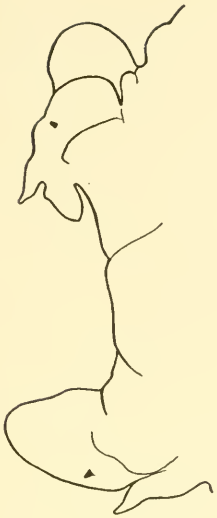

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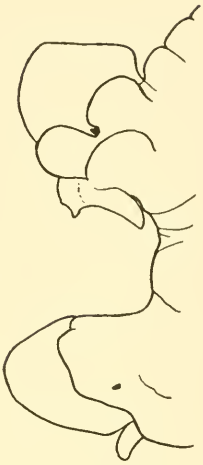

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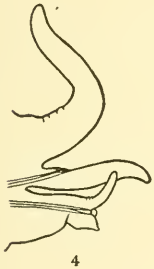

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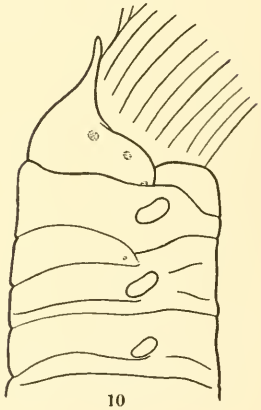

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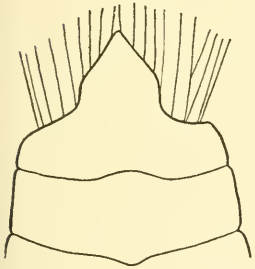

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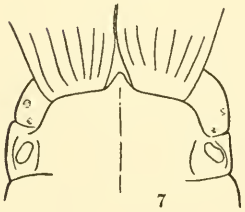

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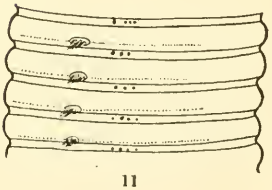

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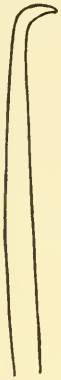
PLATE 2

PLATE 2.

Fig. 1. *Myxicola infundibulum* (Renier). Thoracic hook, x 700.
Fig. 2. *Eudistylia vancouveri* (Kinberg). Collar and base of branchial membrane, in dorsal view, x 11.
Fig. 3. Same. Anterior end, branchiae omitted, in left lateral view, x 11.
Fig. 4. Same. Ventral ends of collar, from specimen killed out of tube, x 11.
Fig. 5. *Eudistylia polymorpha* (Johnson). Collar and base of branchial membrane, in dorsal view, x 11.
Fig. 6. *Pseudopotamilla occelata* Moore. Anterior end, showing notched branchial base and low dorsal collar lobes, x 11.
Fig. 7. Same. First four thoracic ventral plates, from specimen killed out of tube, x 11.
Fig. 8. *Pseudopotamilla intermedia* Moore. Anterior end, showing entire branchial base and well rounded dorsal collar lobes, x 11.



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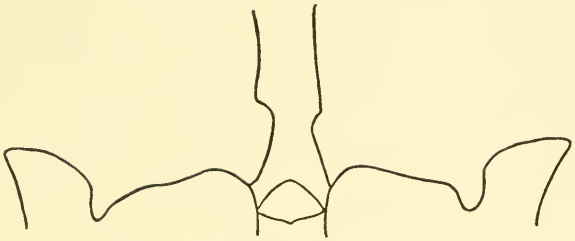

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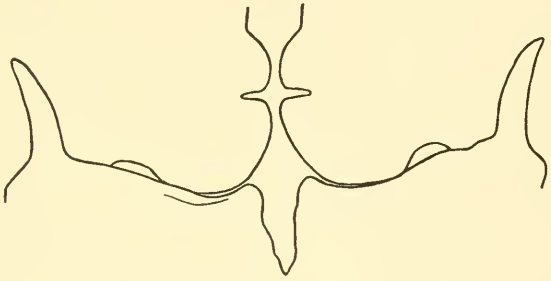

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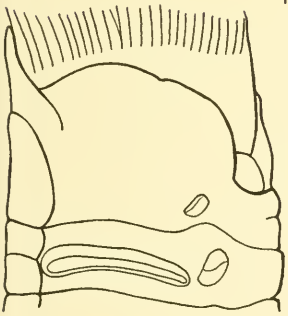

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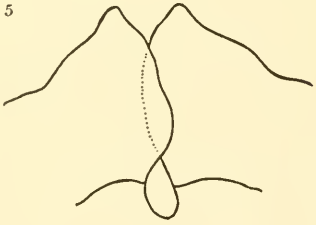

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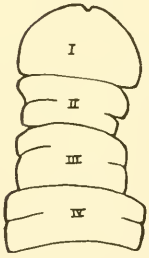

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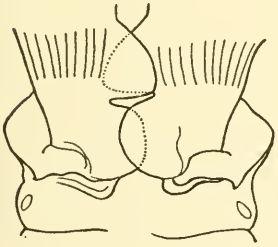

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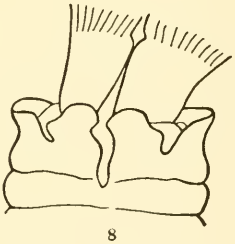

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PLATE 3

PLATE 3.

Fig. 1. *Pseudopotamilla intermedia* Moore. Dorsalmost radiole from right side, showing tentacular membrane and rectangular branchial base at left, x 11.

Fig. 2. Same. Ventralmost radiole from right side with attached palpus, from same specimen as fig. 1, x 11.

Fig. 3. Same. Spatulate seta from first thoracic segment, showing tiny mucron, x 347.

Fig. 4. Same. Uncinus and companion pennoned seta from last thoracic segment, x 347.

Fig. 5. Same. Uncinus and companion pennoned seta from second last thoracic segment, from same specimen as that of fig. 4, x 347.

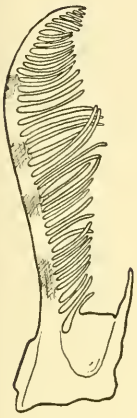
Fig. 6. Same. Neuropodial setae from second abdominal segment, x 347.

Fig. 7. *Eudistylia vancouveri* (Kinberg). Base of dorsalmost radiole from right side, showing tentacular membrane and rectangular branchial base at left, x 11.

Fig. 8. *Sabellaria nanella* Chamberlin. Palea from inner series of opercular crown, x 45.

Fig. 9. Same. Palea from middle series of opercular crown, x 45.

Fig. 10. Same. Palea from outer series of opercular crown, showing simple, smooth distal spine, x 45.



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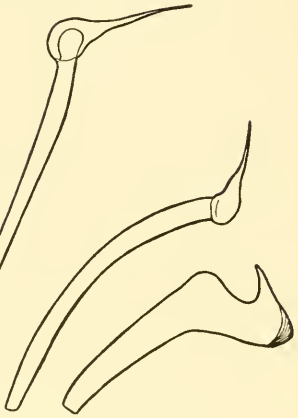

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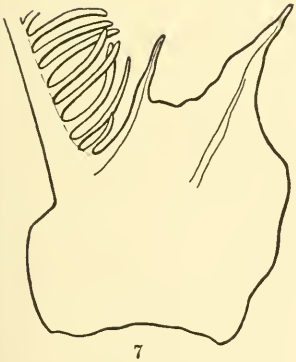

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Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE
VOL. LXXXV, NO. 2

SOME PARASITIC WORMS IN THE HELMINTHOLOGICAL COLLECTION OF THE MUSEUM OF COMPARATIVE ZOÖLOGY

BY J. H. SANDGROUND

CAMBRIDGE, MASS., U.S.A.
PRINTED FOR THE MUSEUM
DECEMBER, 1938

PUBLICATIONS

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

AT HARVARD COLLEGE

There have been published of the BULLETIN, Vols. I to LXXXII, and LXXXV, No. 1 & 2; of the Memoirs, Vol. I to LIV, No. 1, 2 & 3, and Vol. LV.

The BULLETIN and MEMOIRS are devoted to the publication of original work by the Officers of the Museum, of investigations carried on by students and others in the different Laboratories of Natural History, and of work by specialists based upon the Museum Collections and Exploration.

These publications are issued in numbers at irregular intervals. Each number of the Bulletin and of the Memoirs is sold separately. A price list of the publications of the Museum will be sent on application to the Director of the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

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No. 2. — *Some Parasitic Worms in the Helminthological Collection of the Museum of Comparative Zoology*

By J. H. Sandground

I. Descriptions of some parasitic worms from *Solenodon paradoxus* Brandt (Insectivora)

Among the rarest of extant mammals are the two species of Solenodon, *S. paradoxus* Brandt, 1833 and *S. cubanus* Peters, 1861, which together constitute the very distinctive insectivore family Solenodontidae. Nocturnal in their habits, these fairly large, shrew-like animals live in subterranean galleries or in hollow trees and are restricted in distribution to heavily wooded mountains or rain forests on two islands in the Caribbean Sea. Although the small series of study specimens that it has been possible for a few of the world's largest museums to assemble indicates that these animals have always been difficult to procure, it is now generally supposed that with the development of agriculture in Cuba, the species *S. cubanus* has become extinct. Furthermore, since so few specimens of *S. paradoxus* have been secured on the island of Haiti, it was feared that this species had also suffered a similar fate. That this fear was not entirely warranted was proved by a German collector who, in 1935, succeeded in capturing 28 specimens in San Domingo.

Desiring specimens for particular anatomic studies, Professor George B. Wislocki of the Harvard Medical School commissioned the services of Mr. William J. Clench of the Museum of Comparative Zoology, who in the summer of 1937 was leading an expedition into the interior of the Republic of San Domingo. With the aid of native collectors, Mr. Clench was eventually successful in obtaining 3 adult specimens of *S. paradoxus*. Subsequently, while working on the formalin preserved body of one of these animals, Dr. Wislocki observed that the subperitoneal muscles of the pelvis were riddled with encysted parasites. These he kindly turned over to the writer, together with the viscera of this and another specimen. The muscle-invading parasites were found to be the larvae of an as yet unidentified thorny-headed worm (Acanthocephala) which I also found in large numbers attached to the mesenteries and diaphragm and encysted under the capsule of the liver and on the pericardium. Search of the intestine revealed numerous specimens of three other classes of parasitic worms: roundworms in the duodenum, masses of tapeworms in the lower part of the small intestine, and flukes in the colon.

In view of the rarity of the host it is not surprising that the literature of helminthology mentions no previous examination of *Solenodon*. Our studies indicate that at least two of the parasites belong to hitherto undescribed species. On the other hand, the trematode belongs to a genus whose many species are so similar in morphology, that I deem it undesirable to distinguish it with a new specific name.

The type material of the new species described in the following pages is deposited in the helminthological collection of the Museum of Comparative Zoology at Cambridge.

CESTODA

Hymenolepis wislockii spec. nov.

Numerous specimens of this tapeworm were found in the lower part of the small intestine. Small developmental forms ranging upwards in length from 4 mm. and consisting of a few growing proglottids and a scolex were plentiful in the upper jejunum and duodenum. The longest strobilae composed of several hundreds of narrow segments measure in the preserved state up to 80 mm. in length, with an average maximum width of 0.95 mm. Much shorter specimens are numerous. The scolex (fig. 1) presents a variable appearance according to the state of muscular contraction and the position of the rostellum which when everted from its spacious pouch forms a columnar protuberance 0.17 mm. in length and 0.15 mm. wide. Crowning the rostellum is a ring of from 38 to 40 hooks which measure 25 μ to 28 μ from the pointed blade tip to the base of the handle. The guard, about 9 μ long, projects almost parallel to the blade. Figure 2 depicts two hooks that were teased apart from the rostellum and manoeuvred into a single optical plane for camera lucida drawing. When the hooks remain in situ they may present a very different appearance and, depending upon the angle of vision, a wholly erroneous conception as to their size. Scolex about 0.35 mm. wide, with suckers from 0.11 to 0.13 mm. in diameter partially covered by a cuticular fold. Musculature well developed, there being 20 to 22 longitudinal bundles consisting of 7 to 10 muscle fibers in addition to the transverse muscle fibers. Ventral and dorsal excretory vessels pass ventral to the nerve cord and genital ducts. In immature segments the three developing testes lie in a transverse line; in more mature segments (fig. 3) the median testis is pushed forward on the aporal side. Cirrus sac measures 0.17 mm. by 0.06 mm. In addition to the seminal vesical coiled within the cirrus sac there is a voluminous external seminal vesical which in mature

segments extends to the middle of the segment and is persistent even in gravid egg-laden segments. Cirrus, devoid of spines, opens into a scarcely perceptible genital atrium near the middle of the segment margin. Ovary small, slightly lobed, situated mesially together with a very inconspicuous vitelline gland. There is an ampulliform dilation

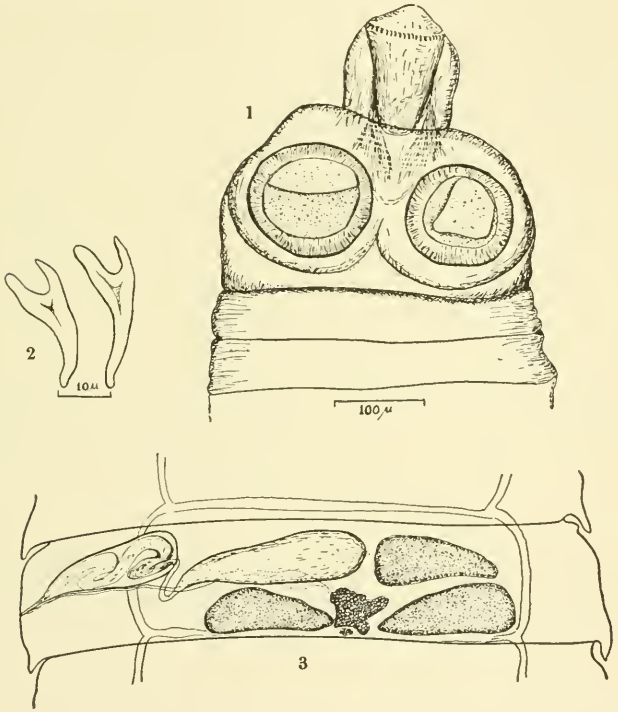

Fig. 1. *Hymenolepis wislockii* Sandground. Scolex with extruded rostellum.
Fig. 2. *Hymenolepis wislockii* Sandground. Isolated hooklets.
Fig. 3. *Hymenolepis wislockii* Sandground. Mature segment.

of the oviduct or receptaculum seminis situated ventral to the external seminal vesical. The vagina runs close to the posteroventral edge of the cirrus sac to open by the side of the cirrus. The uterus when fully formed spreads throughout the segment. The ova in utero in balsam mounts measure from 38 to 41 μ by 30 to 35 μ, but as found extruded naturally from the segment into the contents of the host's gut they measure 60 to 64 μ by 46 to 50 μ in outside diameter.

Species Relations

The genus *Hymenolepis* Weinland, 1858, is perhaps the largest in the entire field of helminthology, some 300 species parasitic in a wide variety of birds and mammals being attributed to it. In an effort to facilitate identification, Mayhew (1925) suggested a segregation of the members of this unwieldy group into 3 genera, but for reasons that have been given by several authorities (e.g. Fuhrmann 1932) these genera have had to be suppressed. In view of the magnitude of the genus and the difficulty of distinguishing many of its species on the basis of descriptions, it is common practise among present day workers to establish the taxonomic status of members by comparing it with those species that have been described from phylogenetically related hosts. The validity of this procedure depends upon the assumption of an ecologically, if not physiologically, determined specificity of the parasite for its host. Obvious as are the potential difficulties in adopting a procedure whose reliability is still largely theoretical, the exigencies of the moment are such that the practise cannot be abandoned, and consequently I shall restrict the discussion of the taxonomic status of the species described here to a comparison with the 30 species of Hymenolepis which have already been recorded from Insectivora. The names of these species together with the morphological features that are deemed of prime differential value are tabulated below.

In view of the plasticity of the body of tapeworms and the changes in topographic relations that the gonads may assume at different stages in growth as well as in death (depending upon fixation methods), the number and shape of the rostellar hooks has been found to provide the most reliable means of distinguishing between species of Hymenolepis. On this basis the species here described shows greatest resemblance to *H. bacillaris* (Goeze, 1782) and *H. tiara* (Dujardin, 1845)[1]. The present species, however, differs from both of the aforenamed species in its much larger cirrus pouch and the size of the eggs as well as in other features. It is consequently believed that the species is new, and it is named *H. wisloekii* as a token of my appreciation to the donor of the material.

[1] In this connection it may be noted that while *H. tiara* is stated by Baer (1928) to have 38 to 40 hooks, it is also described (Baer 1932) to have only 30 to 32 hooks. Whether this difference is an index of intraspecific variation or indicates the existence of two species remains to be shown.

DIMENSIONS OF SPECIES OF HYMENOLEPIS RECORDED FROM INSECTIVORA.[1]

Species	Host Genus	Locality	Length and Greatest Breadth of Strobila (millimeters)	Scolex	Suckers	Hooks (Number : Length)	Cirrus Sac	Eggs
alpestris, Baer, 1931	*Neomys*	Switzerland	7 by 0.36	.21 by .24	.07 by .13	absent	.08 by .03	
anthocephalus Gundy, 1935	*Blarina*	United States	40–100 by .3–.65	.25 by .39	.16 by .11	absent	.08 by .03	47 by 30μ
bacillaris (Goeze, 1782)	*Scalops* *Talpa* *Erinaceus*	United States Europe Europe	150 by .15			36 : 20μ	.12	71 by 80μ
barroisii Moniez, 1880	*Talpa*	Europe						
capensis Janicki, 1904	*Chrysochloris*	S. Africa	30 by 1.2					
chrysochloridis Janicki, 1904	*Chrysochloris*	S. Africa	(?) by .6	.29		16–18 : 29μ		27μ
diaphana (Cholodk., 1906)	*Sorex*	Russia	3 by .23			absent		
dodecantha Baer, 1925	"shrew"	C. Africa	15 by .57	.36 by .38	.095	12 : 32–34μ	.13 by .02	67 by 52μ
erinacei (Gmelin, 1790)	*Erinaceus*	Europe	160 by 1.9			20 : 17μ		
furcata (Stieda, 1862)	*Sorex*	Europe	10 by .34	.21	.08	22–28 : 28μ	.06 by .02	
globosa Baer, 1931	*Neomys*	Switzerland	2 by .19	.29	.18 by .08	absent	.01 by .02	38μ
jacobsoni Linstow, 1907	*Pachyura*	Asia	34 by 1.2			10 : 21μ		
maclaudi Joyeux et al, 1928	*Crocidura*	W. Africa	25 by 1.0	.35	.10	23 : 36μ	.12 by .05	72 by 40μ
macroscelidarum Baer, 1925	*Macroscelides*	S. Africa	34 by 2.0	.23	.08	20 : 19–21μ	.13	36μ
magnirostellata Baer, 1931	*Neomys*	Switzerland		.26	.14	20–24 : 30μ	.14 by .05	42 by 30μ
minutissima Meggitt, 1927	*Crocidura*	India	2 by .5	.12		12 : 16–18μ		
moniezii Parona, 1893	*Pteropus*	Asia				absent		
neomidis Baer, 1931	*Neomys*	Switzerland	8 by .19	.3 by .4	.15 by .08	18 : 22μ	.10	
petrodromi Baer, 1933	*Petrodromus*	S. Africa	20 by .95			10 : 11–13μ	.15 by .03	
peipingensis Hsü, 1935	*Talpa*	China	750 by 1.9	.26	.11 by .09	absent	.21 by .05	
pistillum (Dujardin, 1845)	*Crocidura* *Sorex*	France	2 by .3	.17	.05	14–22 : 14μ	.06	62 by 48μ
polyacantha Baer, 1932	*Neomys*	Switzerland	18 by .13	.38	.16	62 : 15–16μ	.08 by .02	38 by 27μ
scalaris (Dujardin, 1845)	*Crocidura* *Sorex*	France	34 by 1.2	.48	.90	10–13 : 21–33μ	.07	70 by 40μ
singularis (Cholodk., 1912)	*Sorex*	Russia	2.5 by .3	.50	.14 by .11	10 : 62μ	.76 by .02	53 by 42μ
solitaria Meggitt, 1927	*Crocidura*	India				16 : 17μ		
soricis Baer, 1925	*Sorex*	France	0.3 by .08	.13	.07 by .06	absent		
spinulosa (Cholodk., 1906)	*Sorex*	Russia	30 by .5	.30	.09	18–20 : 37μ	.03	46μ
tiara (Dujardin, 1845)	*Sorex* *Crocidura*	Europe	30 by .7	.30	.05	38–40 : 26μ	.08	34μ
toxometra Baer, 1932	*Sorex*	Switzerland	6 by .24	.21	.12	10 : 35μ	.04	42μ
uncinata (Stieda, 1862)	*Sorex*	Switzerland	15 by .56	.32	.10	18–22 : 17–22μ	.04	56μ
wislockii mihi	*Solenodon*	San Domingo	80 by .95	.35	.11	38–40 : 28μ	.17	64 by 50μ

[1] The data here tabulated have been assembled from original as well as secondary sources. The dimensions of certain species as given by different authors vary considerably, but it is impossible to determine whether this is to be ascribed to a confusion of the species or to a natural intra-specific variation. In view of the limitations of space, only maximum figures are usually presented in this table. Species that have already been relegated to the synonymy are not included.

TREMATODA

Brachylaemus sp.

From the colon of one of the two specimens of *Solenodon paradoxus* dissected, eleven greyish colored flukes were recovered. These small worms in the preserved condition are almost round in cross section; the two bluntly attenuated extremities tend to bend ventrally so that from the side the worms are crescentic in shape. The pressure used in flattening specimens for the preparation of toto mounts causes a slight increase in width and may also derange other proportions of the body. The following measurements were all taken from toto mounts (fig. 4). Length 2.2 to 2.85 mm. Breadth at widest point 0.65 to 0.75 mm. Cuticle over preacetabular zone ornamented with minute spines. The spinosity is more difficult to detect in some individuals than in others. Oral sucker circular to elliptical in outline with diameter ranging from 0.25 to 0.35 mm. The mouth opening is partially covered by a fold of cuticle. Pharynx more or less spherical, 0.16 to 0.18 mm. in cross section. Intestinal crura bend anteriorly around the pharynx and subsequently run a very sinuous course, partially covered by the uterine coils, practically to the caudal extremity. Acetabulum, at junction of anterior third of body, 0.27 to 0.31 mm. in diameter. The short main stem of the excretory vesical opens subterminally on the ventral surface. Vitellaria, consisting of a narrow band of follicles, extend from the posterior level of the acetabulum to the level of the anterior testes; the transverse vitelline ducts dilate to form a conspicuous reservoir crossing the ovary. Unsatisfactory fixation and the thickness of our specimens make for poor differential staining so that for the determination of the relationship of the genital ducts it has been necessary to rely largely upon serial sections. The gonads lie tandem in the median axis in the posterior quarter of the body with the ovary situated between and practically contiguous with the testes. The testes and ovary are all regular in outline; the latter organ (0.18 to 0.25 mm. in diameter) is only slightly smaller than the two testes. Even though Odhner's definition of the Brachylaemidae mentions the absence of a receptaculum seminis, our sections reveal a thin-walled sperm-containing dilation of the complex of ovarian ducts, just below the ovary. This we can only interpret as a seminal receptacle. Baer (1928), Werby (1925), and others have also depicted a receptacula seminalis in various species of this genus, but Joyeux et al (1934) deny its presence, interpreting the structure as an elongate oötype. No trace of Laurer's canal was seen. The uterus is very

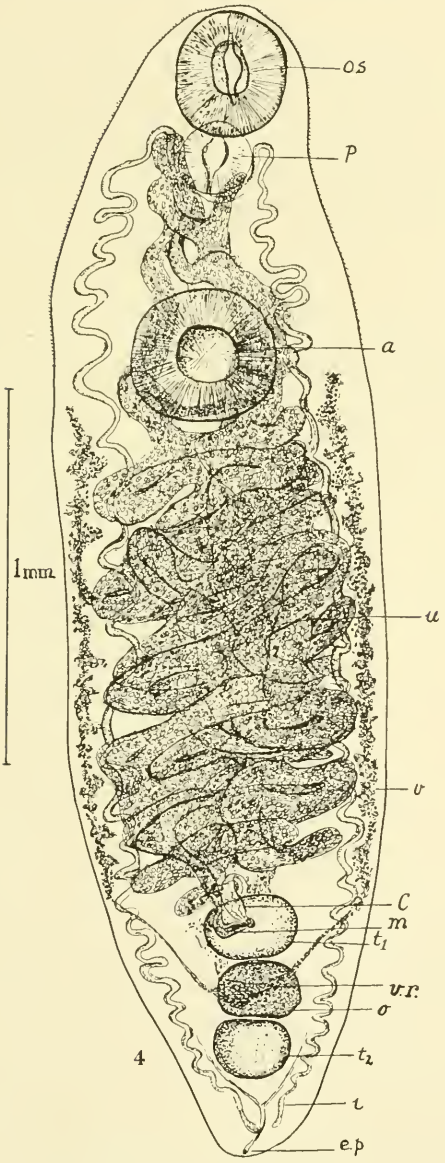

Fig. 4. *Brachylaemus sp.* Ventral view of toto-mount.

Abbreviations: o.s.–oral sucker, p.–pharynx, a–acetabulum, u–uterus, v–vitellaria, c–cirrus organ, m–metraterm, t_1 and t_2–testes., o–ovary, i–intestinal caeca, e.p.–excretory pore.

voluminous, its coils (containing countless golden color eggs which measure 13–16μ by 24–28μ) extend beyond the acetabulum to the region of the pharynx. The metraterm and the cirrus pouch open into a common genital atrium, which is situated in the median ventral line well in the zone of the anterior testis. In toto mounts the genital pore is placed over the center of the testes; in lateral view it opens ventrally at the side of the testes.

Systematic Relations

Members of the genus *Brachylaemus* (syn. *Harmostomum*) are very muscular, and in life the body is capable of considerable extension, more especially in the anterior region. They lose their motility soon after the death of their host and the body contracts markedly, sometimes producing superficial wrinkling. Not only do measurements become a poor criteria of the species as a result of variations in contraction, but the intestinal caeca take on undulations and the position of the genital pore relative to the anterior testis may be altered. The morphology of the organs varies apparently also with the state of maturity. As a consequence of these variations, the identification of species becomes a very difficult matter as attested by Dollfus (1934 and 1935) and by Joyeux, Baer and Timon-David (1934), who have recently assayed a revision of the genus, whose representatives are found in several orders of birds as well as in 3 orders of mammals.

The names of eleven species parasitizing members of the Insectivora are listed in the key catalogue of Stiles and Stanley (1932). Although many of these have been placed in synonymy by Baer (1928) and by Dollfus (1934), considerable uncertainty still exists regarding the validity of the remaining species. While it is to be hoped that life history studies will eventually elucidate the taxonomic status of many, the demonstrated fact that at least some species do not exhibit a high order of host specificity will not tend to reduce the existing uncertainty (see Krull, 1933 and Dollfus, Callot and Desportes 1935). Rather than complicate the already perplexing problem I think it desirable to ascribe no specific name to the species here described. It may however be noted that the species does not appear to differ significantly from *B. helicis* (Meckel, 1846) as recently described by Baer (1928) from European hedgehogs, nor from the species *B. opisthotrias* (Lutz, 1895) from South and North American opossums, as described recently by Dickerson (1930).

NEMATODA

Shattuckius shattucki gen. et spec. nov.

Slender worms disposed to be loosely coiled in two or three whorls. Cuticle very faintly striated transversely and more conspicuously marked by about 16 longitudinal lines or elevated crests. There is an asymmetric inflation of the cuticle of the head for a distance of about 0.075 mm. (fig. 5). Cervical papillae apparently absent. Buccal

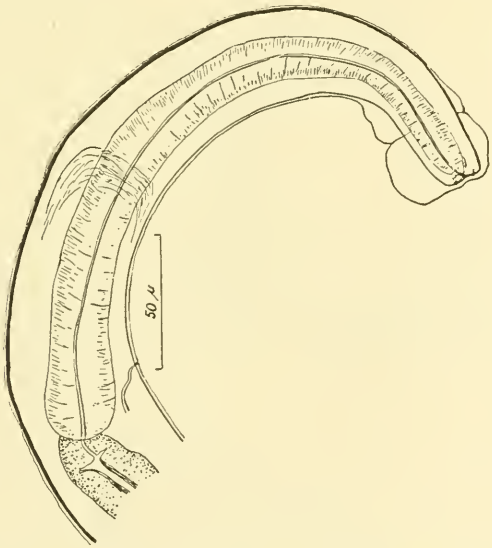

Fig. 5. *Shattuckius shattucki* Sandground. Anterior extremity.

cavity vestigial; without obvious lips but surrounded by 4 cephalic papillae. Oesophagus claviform, 0.31 mm. and 0.34 mm. long in male and female respectively; encircled by nerve ring near its middle.

Male 3.3 to 3.5 mm. long and 0.075 mm. maximum width. Female 5.4 to 5.7 mm. long with 0.085 mm. maximum width. Tail of female (fig. 6) 0.11 to 0.12 mm. long with a spinous process at its bluntly rounded tip. Vulva located 1.3 to 1.4 mm. from the caudal extremity; the cuticle around its rim (fig. 7) is slightly inflated making the vulva fairly conspicuous. Ovejectors about 0.16 mm. long. Eggs with very thin shells measuring in utero 48 to 50 μ by 32–35 μ.

Bursa of male (fig. 8) relatively spacious. There is a distinct though small dorsal lobe. Lateral lobes adorned with a punctate striation

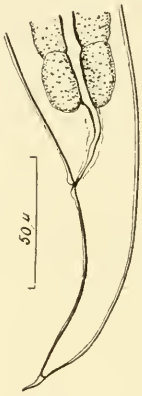

Fig. 6. *Shattuckius shattucki* Sandground. Tail extremity of female.

along their internal postero-lateral margins. There is a small accessory membranous lobe, apparently devoid of supporting ribs. Prebursal papillae and telamon apparently absent. The long, relatively slender

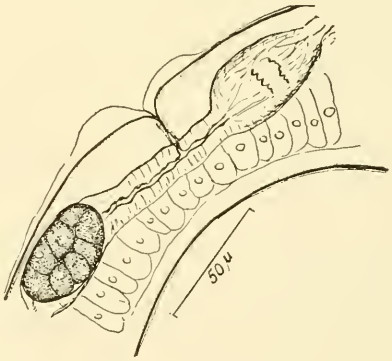

Fig. 7. *Shattuckius shattucki* Sandground. Region of vulva.

externo-dorsal ray originates from a common trunk with the robust dorsal ray and is the only ray that does not extend to the margin of the bursa. The dorsal ray gives off serpentine lateral rays before

bifurcating. On each branch of the divided dorsal ray, at about the mid-point there is an external bud, representing a vestigial digital process. Lateral rays about equal in size and well separated from each other. Ventral rays subequal, divergent from their common trunk to the bursal margin. Spicules (fig. 9), equal in size, about 70μ long, sparsely punctate on their surface. They are of unusually simple form,

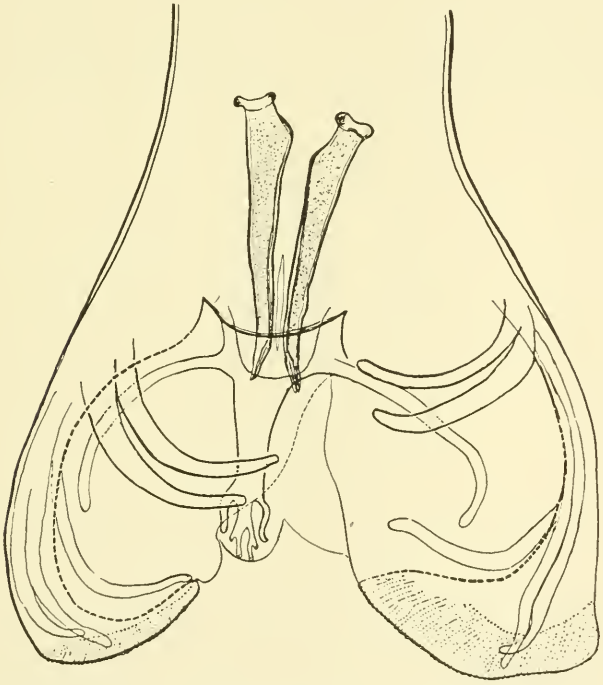

Fig. 8. *Shattuckius shattucki* Sandground. Posterior extremity of male.

devoid of lateral angular prominences and having only a single, very faint crest running longitudinally. It requires the highest possible magnifications to show that the spicule tips do *not* terminate in simple, acute points, but that they are cleft for a short distance to present two or possibly three splinter-like processes united by a transparent membrane. There is a very faintly cuticularized gubernaculum about 25μ in length. *Systematic Relations.* From Stiles and Stanley's Key Catalogue (1932) we learn that the only representatives

of the Trichostrongylidae recorded from the Insectivora are a number of species of *Viannaia* (Heligmosominae). The parasite described above, therefore, appears to be the first didelphous form, or member of the subfamily Trichostrongylinae, to be reported from this order of mammals. A review of the literature indicates that our species is clearly a new form, but, because the number of genera in the Trichostrongylinae has been multiplied to such an extent by recent workers, the establishment of its taxonomic affinities has not proved simple. Superficially the species appears to be related to *Cooperia*, but the spinous process that tips the tail of the female and the subequality in size of the ventro-ventral and latero-ventral rays as well as other

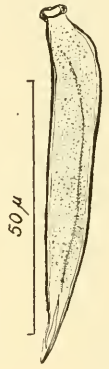

Fig. 9. *Shattuckius shattucki* Sandground. Spicule isolated by dissection.

characters, immediately separate it from members of this genus. In respect to these same features it appears to show greater resemblance to the genera *Molineus* Cameron, 1923 and *Maciella* Travassos, 1935. From both of these genera, however, it differs in the division of its dorsal ray and in the relatively plain structure of its spicules. We should prefer to regard characters of this order as having no more than specific value, in this way avoiding the oftentimes dubious creation of new genera, but the taxonomic standards that have been so generally adopted leave no alternative but to create a new genus which I name in homage to my colleague Dr. George C. Shattuck and briefly define as follows:

Trichostrongylinae. Cuticle faintly striated transversely, and with about 16 longitudinal crests. With asymmetrical cephalic inflation

but without cervical alae or cervical papillae. Vestigial buccal capsule. Female with mucronate tail; vulva postmedian. Eggs segment in utero. Bursa ample, with distinct dorsal lobe. Internal surface of lateral lobes ornamented along posterior borders. A very small accessory membrane present. Ventro-ventral and latero-ventral rays subequal and extending to bursa margin. Lateral rays about equally

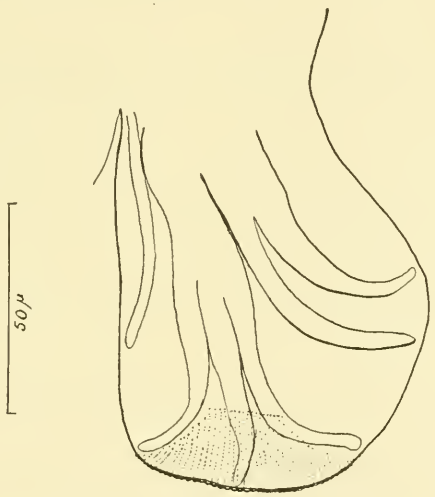

Fig. 10. *Shattuckius shattucki* Sandground. Lateral lobe of the bursa with supporting rays.

long and well separated. External-dorsal, long and slender, but not attaining margin, arises from common trunk with the massive dorsal ray. Dorsal gives off lateral branches before bifurcating into two halves, each of which has a small aborted process near its middle. Spicules relatively regular in outline, with well developed knob cephalad and cleft terminally into two or three parallel splinters. Gubernaculum acicular, very poorly chitinized. Prebursal papillae apparently absent.

Genotype. *S. shattucki.*

Habitat. Duodenum of *Solenodon paradoxus*, Santo Domingo.

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2. A redescription of TETRAPETALONEMA DIGITATA (Chandler, 1929) comb. nov., a filariid parasite of Gibbon Apes, with an enumeration of its congeners.

Under the designation *Dirofilaria* (?) *digitata*, n. sp., Chandler (1929) described three female filariid nematodes found in the abdominal cavity of a *Hylobates hoolock*, which had died in the Calcutta Zoological Garden. In 1933, the present writer recorded the occurrence of the same species in an Annamese gibbon, *Hylobates leucogenys* from French Indo-China, but again because of the absence of male worms it was not possible to erase the mark of interrogation originally inserted by the discoverer of the species to emphasize the element of uncertainty in his generic designation.

Recently the Museum received a collection of parasitic worms that, in an incidental way, had been secured by the Asiatic Primate Expedition under the leadership of Harold J. Coolidge, Jr. In the collection were specimens of *Dirofilaria pongoi* Vogel and Vogelsang, 1930, taken from (1) an orang-utan, *Pongo pygmaeus* and (2) *Hylobates funereus*[1] at Abai, in N. Borneo. Also there were several bottles containing very large numbers of Chandler's above-mentioned species which forms the subject of the present paper. This parasite had been found in a majority of adult gibbons, *Hylobates lar entelloides* (Geoffroy) taken at an altitude of 1000 m. on Mt. Intanon, near Cheingmai in northern Siam. At lower altitudes and in other portions of their range, the gibbons appeared to be free of filariasis. The collectors were greatly impressed by this epidemiological observation, and were also surprised that no signs of disease was manifested by apes so heavily infected that the peritoneal cavity and sometimes also the pleural cavity appeared to be crammed, "like a bowl of vermicelli" with crawling masses of worms.[2]

A study of this abundant material now enables us to describe for the first time the male of Chandler's *D. digitata* and to transfer the species to the genus *Tetrapetalonema*.

[1] This appears to be the first record of *D. pongoi* in a gibbon.

[2] From the field notes of Professor A. H. Schultz of Johns Hopkins Medical School, and Dr. C. R. Carpenter of Bard College, two members of the expedition, we learn that infants (i.e. under one year of age) were rarely infected; 12 of 19 juvenile gibbons carried sparse infections, while only two out of eighty adults were apparently free of filariid worms. In two of the latter it was noted that the ovaries were cystically enlarged with worms penetrating into the substances of the organ. In contrast with the high incidence and great intensity of infection with *T. digitata* that was encountered in gibbons captured in the forests, it was found that families of the same host species that lived segregated outside of the forest were free of infection. It seems possible that this observation may have special significance from the standpoint of the probable insect vector of the parasite.

We desire here to express our appreciation to Dr. O. E. McCoy of the University of Rochester, New York, who presented to the Helminthological Collection of our Museum valuable specimens of *T. marmosetae* Faust, 1935, *T. atalensis* McCoy, 1936, and *T. parva* McCoy, the three species at present embraced in the genus. The examination of this material has been of great aid in considering the taxonomic status of the forms involved.

Tetrapatelonema digitata (Chandler, 1929)

The following account is based on a study of more than twenty representatives of each of the sexes taken from several specimens of the host.

Conforming with its congeners, this species is a very slender, thread-like worm. A marked attenuation of the body commences at an appreciable distance from the extremities. The flagelliform nature of the head and tail ends thus produced is more conspicuous in this species than in those described from New World monkeys. There is no noticeable guttural dilatation or annular swellings in other parts of the body such as are characteristically found in *T. marmosetae* and *T. atalensis* (cf. McCoy, 1936).

Although the cuticle in this genus has invariably been described as smooth or unstriated, close examination of specimens of probably all species which have not been subjected to complete clearing will show that the cuticle is striated with very fine lines at about 1.5μ intervals.

The anterior end of the body is bluntly rounded and about 30μ wide in *T. digitata*. There is no semblance of a reinforced integumentary shield, cuticularized cap or analogous cephalic ornamentation such as is found in some of the genera that have incorporated in the subfamily Setariinae of Yorke and Maplestone. In a frontal view of the head (fig. 11) as well as in lateral view (fig. 12), eight delicate cephalic papillae in the subdorsal and subventral positions can be made out. They are arranged in a manner common among genera in the Filariidae. Although in frontal view the papillae may appear to be almost contiguous, they are actually well separated and it would be misleading to describe them as "twinned papillae at each corner of a rectangular peribuccal plate," whereby the inference could be drawn that, by a process of approximation or fusion, the papillae have been doubled, in analogy with the "double papillae" frequently seen on the lips of ascarids.

The lateral papillae, or, more correctly, amphids, are in the form of

minute slit-like organs which are rather difficult to discern on the surface of the cuticle. These organs have by error been described by both

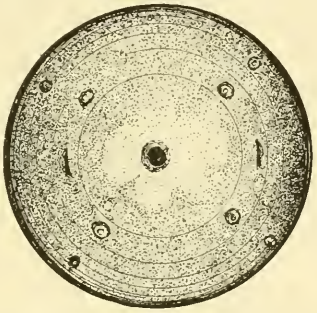

Fig. 11. *Tetrapetalonema digitata.* Frontal view of head.

Faust and McCoy as located in the mid-dorsal and mid-ventral fields.

The minute oral aperture is simply a rounded pit without an elevated rim. It is difficult to get a clear impression of the structure of the

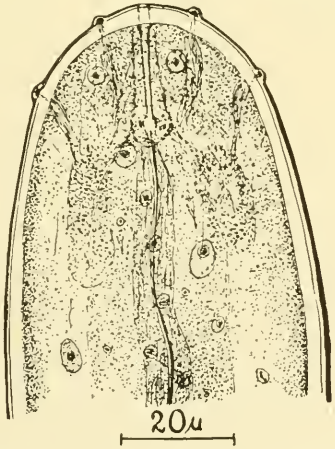

Fig. 12. *Tetrapetalonema digitata.* Anterior extremity in lateral view.

alimentary canal immediately behind the mouth owing to the region being obscured by strands of nerve fibers, glandular cells and other subdermal structures. Yet, in translucent specimens examined after

minimal clearing, the presence of a relatively refractile, tubular structure, about 25 μ in length is to be made out. This structure is in favorable specimens quite discrete, and is to be interpreted as a vestigial or rudimentary buccal capsule; it sometimes appears to be protrusible and may function as a piercing organ or stylet. Its presence is described or illustrated in some of the other species which we attribute to this genus (e.g. *Parlitomosa zakii* Nagaty), and upon its existence depends our views as to the taxonomic affinities of the genus.

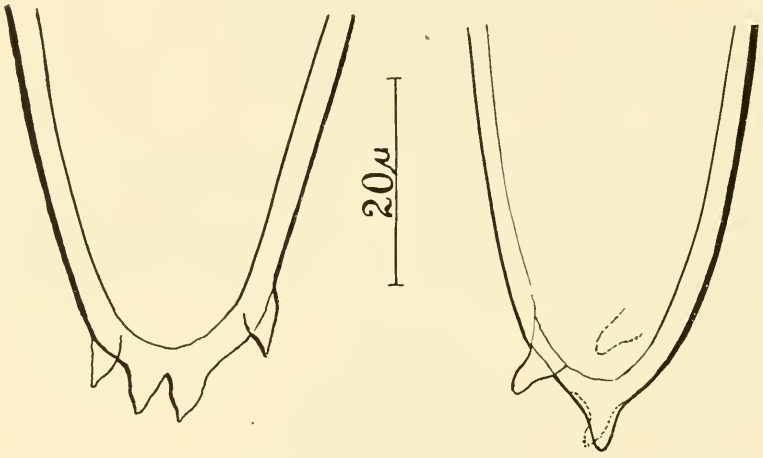

Fig. 13. *Tetrapetalonema digitata.* Posterior extremity of female; ventral and lateral views.

The alimentary canal throughout its length is weakly developed. It is especially difficult to describe the oesophagus (which is only about 20 μ wide) when the specimens are completely cleared in lacto-phenol solution or glycerin. Faust's and McCoy's descriptions omit all reference to the alimentary canal. Chandler described the oesphagus of the species *digitata* as "very fine and slender, only about 11 μ in diameter and not easily observed except where it is bent and runs at an angle to the long axis of the body. The junction with the intestine is not sharply demarcated, the intestine tapering, cone-like, to the junction with the oesophagus." Only by attempting to follow the course of the lightly cuticularized lining of the oesophagus to the point where it appears to end and where the coarser granulation of the intestinal cells commences does it appear possible to determine the

approximate length of the oesophagus in our material. In the females this point is more difficult to detect than in male worms because the muscular dilatation of the vagina obscures the oesophago-intestinal

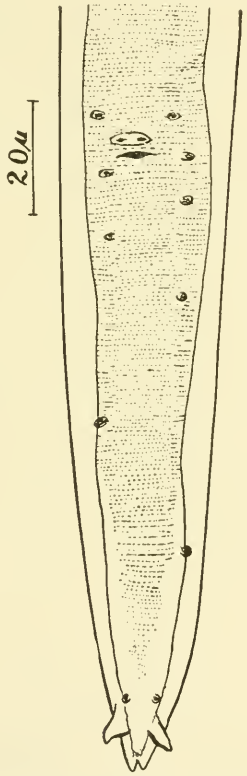

Fig. 14. *Tetrapetalonema digitata*. Caudal region of male, ventral view, showing distribution of papillae.

junction. Consequently measurements of the oesophagus are no better than approximations which can be accorded no critical values.

The vulva is not salient, but the massive vaginal chamber, or ejector, allows its position to be easily located. The vagina runs a rectilinear course posteriad for 2 to 3 mm. and then divides into two uteri that are packed with microfilariae. As expressed from the uteri the fully developed larvae measure in watery solution from 170 to 188 μ

in length and about 4μ in width. They are without a sheath and the posterior region tapers to a blunt end. Owing to the lack of suitable

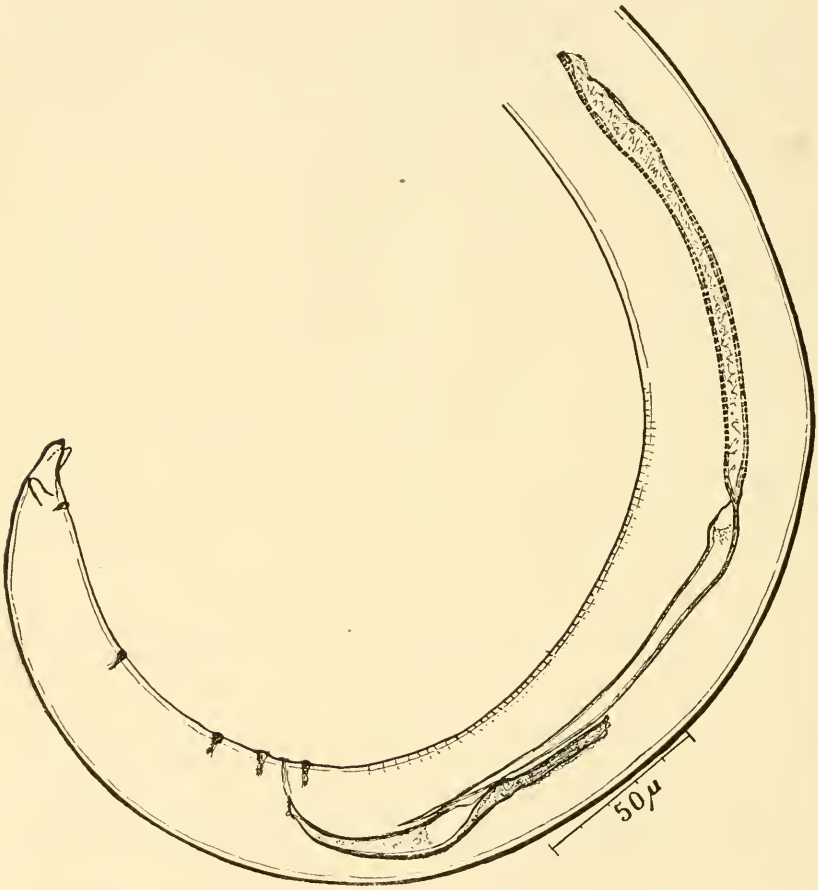

Fig. 15. *Tetrapetalonema digitata.* Caudal region of male, lateral view, showing characteristic shape of the spicules.

blood smears we cannot describe the finer details of the microfilaria morphology.

The anus in the female has a rudimentary appearance indicating, perhaps, functional atrophy. The tip of the tail has a shallow cleft,

and is ornamented by a pair of cuticular lappets, about 4μ in length, which originate on the subventral surface (fig. 13).

In the preserved state the tail of the male is disposed in a loose two-looped spiral. The structure of its tip is essentially the same as described for the female. There are very narrow lateral expansions of the cuticle suggesting caudal alae, but these appear to be artefacts which are visible only when the tail is flattened by pressure from the cover-glass. The caudal papillae are very minute, sessile and subventrally situated. Usually they number three pairs in the peri-cloacal zone, one pair mid-caudal in position and a fifth pair immediately in front of the terminal lappets. As in many filariid species, the caudal papillae are subject to a degree of numerical irregularity and they are often asymmetrically disposed (fig. 14).

The spicules have specifically distinctive forms illustrated in figure 15. The "shaft," or proximal cylindrical portion, of the left spicule is as long or slightly longer than its more filamentous, leash-like, distal portion. The right spicule resembles a sickle in having a well defined "handle" and an arcuate "blade." In none of our specimens did we find the spicules exserted so as to permit the examination of their extremities. In this connection it may be of interest to note that the relatively long, filiform, left spicule in other species of the genus always appears to be extruded in fixed material.

There is no trace of a cuticularized accessory piece or gubernaculum.

The dimensions of *T. digitata* are given in the appended table.

Taxonomic Relations

As mentioned in our introduction, prior to the present re-allocation of *D.* (?) *digitata* Chandler, three species had been definitely assigned to *Tetrapetalonema* which, imputed to be closely allied to the genus *Dipetalonema*, has been referred to the Setariinae.

A survey of the recent helminthological literature allows us to transfer an additional three species to Faust's genus: (1) *T. nieollei* (Mazza, 1929) and (2) *T. tenuis* (Mazza, 1929) both parasites of *Cebus* spp. from the northern "chaco" of Argentina; (3) *T. zakii* (Nagaty, 1935), a parasite of the Brazilian *Leontocebus rosalia.*

It is not improbable that other parasites of primates incompletely described as species of Filaria by early helminthologists such as Molin may also be members of *Tetrapetalonema.* Furthermore, it is possible that *Tetrapetalonema* is a synonym of *Mansonella* Faust, 1929, whose type and only species, *M. ozzardi* (Manson, 1897) parasitic in man in

the Neotropical region, has been very insufficiently described on the basis of the female worms, which are very tenuous and have tails carrying minute lappets resembling the structures found in *Tetrapetalonema spp.*

In describing *Parlitomosa zakii*, a species that appears to be very closely related to *T. marmosetae*, Nagaty (1935) referred his new genus to the Filariinae and compared it with such genera as *Litomosa, Macdonaldius, Ackertia*, etc. In a more comprehensive review than we are at present able to undertake, several of these recently proposed genera, whose differentiation is rather indefinite, will have to be taken into account.

In this paper our consideration will be confined to those species of *Tetrapetalonema* that have been named above. In so far as several of these have been described in journals that are not widely accessible, it has been deemed desirable to present in tabular form that facilitates comparison, such measurements of the species as have been provided in the original descriptions.

Among many groups of parasitic nematodes, particularly those belonging to the Filariidae, differences up to 100% or even more in the gross size of individual worms, supposedly belonging to a single species, are not rare. Even the dimensions of the spicules and the proportionate length of such organs as the oesophagus are often subject to considerable variation. The taxonomic significance of divergencies such as these has been well recognized by some helminthologists, but their evaluation is difficult. Only by securing material from controlled experimentally induced infections does it appear possible to determine whether these variations are inherent in the constitution of individual worms without reference to any influence that the environment (involving such factors as unfavorable host species, etc.) may exert upon growth, or whether the differences are due to random samplings of worms of different ages, whose growth does not cease with the attainment of sexual maturity. For the critical student of helminthology, at least a notion of the extremes in the variation range is desirable before commensural data can be accepted as valid differential criteria for species that have not been distinguished from their congeners on a structural basis of constant nature.

As the accompanying table shows, although the dimensions in some species of *Tetrapetalonema* show appreciable variation, no indication of the size range is available for at least four of the seven supposedly distinct species. On the basis of present figures, three species (namely: *T. digitata, T. marmosetae* and *T. parvum*) appear to be separable on

TABLE

Species	*digitata*	*marmosetae**	*zakii*	*atatalensis**	*parvum**	*nicollei*	*tenuis*
Author	Chandler, 1929	Faust, 1935	Nagaty, 1935	McCoy, 1936	McCoy, 1936	Mazza, 1929	Mazza, 1929
Males							
Length	100–130	26–45	41	32	16.5–19	93	30
Maximum width	0.23–.27	0.07–.10	0.11	0.08	0.07	0.25	0.09
Length oesoph.	1.1–1.46		0.33	0.55			
Length tail	0.11–.12	0.10–.11		0.08	0.08	0.06	0.07
Spicule right	95–120 μ	180 μ	49 μ	220 μ	140 μ	300 μ	
Spicule left	250–310 μ	660–720 μ	350 μ	770 μ	640 μ	1000 μ	
Females							
Length	220–260	70–117	105	49–63	28–49	209	74
Maximum width	0.46–.55	0.17	0.2	0.15	0.17	0.6–.8	0.25
Length oesoph.	ca. 1.1			ca. 0.85			
Vulva from head	0.95–1.2	0.86–1.0	0.71	0.8–.93	0.5–.68	1.8	0.85
Length tail	0.33–.46	0.2–.32	0.1–.16	0.16–.2		0.3	0.35
Microfilaria	170–188 μ	299 μ	306–342 μ	205 μ	187 μ		
Host.	*Hylobates hoolock*, *H. leucogenys*, *H. lar*	*Leontocebus geoffroyi*, *Saimiri örstedii*.	*Leontocebus rosalia*	*Ateles geoffroyi*, *A. dariensis*	*Cebus capucinus*, *Saimiri örstedii*	*Cebus azarae*, *C. libidinosus*.	*Cebus libidinosus*

*These measurements have been extracted from the original descriptions and are supplemented by additional measurements made by the present author from specimens identified by Dr. O. R. McCoy.

commensural data. However, some of these species may be distinguished on criteria that are of greater taxonomic value than length. Thus in our experience, *T. digitata* may be recognized by the characteristic form of both spicules in the male, the right spicule, for example, being sickle-shaped and more easily seen than in *T. marmosetae*, *T. atalensis* and *T. parva*. On the other hand the buccal vestibule in *T. atalensis* is a well developed organ of characteristic shape (figure 16) which may be contrasted with the cylindrical, more or

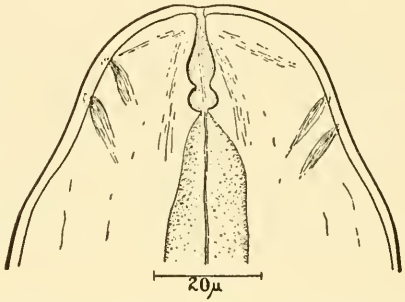

Fig. 16. *Tetrapetalonema atalensis* McCoy. Anterior extremity in lateral view showing buccal capsule.

less diaphanous buccal capsule in the species *parva*, *marmosetae* and *digitata*. Furthermore, according to McCoy, the size of their respective microfilariae affords another means of distinguishing between certain of the species.

Without recourse to authentically identified specimens it is not possible to venture an opinion on the status of *T. zakii*, *T. nicollei* and *T. tenuis*. The descriptions of the two last mentioned species leave much to be desired. Their taxonomic integrity, and, hinging upon this, the nomenclatural status of other species in the genus, including the genotype, will remain in doubt until more complete descriptions are forthcoming.

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3. Setaria hyracis Baylis, 1932, a synonym of S. loveridgei Sandground, 1928

In 1928 I described *Setaria loveridgei* n.sp. on the basis of a few filariid nematodes that Mr. Arthur Loveridge had collected in Tanganyika from the hyrax, *Procavia brucei prittwitzi* at Dodoma, Tanganyika Territory. Four years later, Baylis (1932) described what appeared to be a second species of this genus, *S. hyracis* from a tree dwelling hyrax, *Dendrohyrax sp*, of the Belgian Congo (Sakuru), differentiating his species from *S. loveridgei* on such criteria as the smaller size, longer spicules and differences in the number and arrangement of the caudal papillae in the male.

In more recent years I have had occasion to identify specimens of *Setaria* taken from *Procavia brucei frommei, P. scheffleri* and *Dendrohyrax* (?) *arboreus* collected in various localities in Kenya Colony, Tanganyika and the Belgian Congo. As a result of these studies I have come to the conclusion that all of the material from the above named hosts comprised a single but highly variable species, presumably to be identified with *S. hyracis*. However, a re-examination of the type specimens of *S. loveridgei* has shown that a serious error was made in my original description of the spicules of this species.

The material upon which the description was based was extremely dark in color and even bleaching in hydrogen peroxide failed to render the two male worms as translucent as was desirable. In the male worm that was chosen as type, the right spicule was partially exserted. Re-examination has shown that what I originally took to be two spicules closely applied to each other along one side, is actually nothing more than the exceptionally broad proximal part of the right spicule, whose distal extremity was broken off; the right spicule, situated a considerable distance further forward was overlooked on account of the poor visibility. A study of the second male specimen shows the spicules to be of essentially the same form and size (right; 0.25 mm.; left; 0.59 mm.) as described by Baylis for *S. hyracis* and as found in specimens from other species of hyrax. With these specimens, also, *S. loveridgei* coincides in the general pattern of male caudal papillae and the appearance of the tooth-like projections in the circumoral ring, although it should be noted that the variation in the appearance of this structure is comparable with that described for *S. hornbyi* by Thwaite (1927).

As with many other members of the Filariidae, great disparity is to be found in the length of specimens of *Setaria loveridgei* from different

species of hosts. In our first lot of material from *Procavia brucei*, the two males measured respectively 135 and 160 mm.; from *P. scheffleri* male worms vary in length from 100 mm. to 115 mm.; a single male taken from *Dendrohyrax* (?) *arboreus* is no longer than 65 mm. In the absence of any other taxonomically significant differences in these worms, it appears safest to regard them as intra-specific variants.

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STUDIES OF DEEP-SEA ANGLER-FISHES (*CERATIOIDEA*)

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Member of the Society of Fellows, Harvard University

CAMBRIDGE, MASS., U.S.A.
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STUDIES OF DEEP-SEA ANGLER-FISHES (*CERATIOIDEA*)

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No. 3 — *Studies on Deep-sea Angler-fishes* (Ceratioidea)[1]

By Talbot Howe Waterman[2]

I. An historical survey of our present state of knowledge

In 1833 a strange and theretofore unknown fish was thrown up on the beach near Godthaab, Greenland, after a severe storm. It was remarkable for its bulky rounded body lacking ventral fins, black skin sparsely set with large spine-bearing plates, and especially for the "frontal tuft" arising from a longitudinal trough on the forehead and terminating in a bunch of filaments. Captain-lieutenant Carl Holböll procured this fish, unfortunately badly damaged by birds and decay, and sent it to Prof. Joh. C. Reinhardt at Copenhagen. The latter in 1837 described the specimen, which was fifty-eight centimeters in length, as adequately as possible under the circumstances and named it *Himantolophus groenlandicus*. Because of the lack of proper material for study, Reinhardt was not explicit in placing his type in any of the known groups of fishes, but his comparison of this new form with Antennarius and Lophius, especially with reference to the "Pandedusk," or fontal tuft, of Himantolophus, which he thought to be the same structure as, but more highly developed than the first dorsal ray on the head of Lophius, indicated that he believed his species to be related to those fish which comprise the Order *Pediculati* (Regan 1912). *Himantolophus groenlandicus* was the first deep-sea angler-fish to be discovered.

Before 1845 the same Captain Holböll who had collected this Himantolophus had obtained from the deep-sea off Greenland two more new "barbugede Tudsefiske" (called bare-bellied by the Danes because ventral fins are lacking in all the known ceratioid pediculates). One of these two was described in 1844 by Prof. H. Kröyer as *Ceratias holbölli*, while the other remained unnoticed, at least in the literature, until Prof. Chr. Lütken rescued it from dusty oblivion and described it as *Oneirodes eschrichtii* in 1871. Today these first specimens are considered members of three distinct families of the Suborder *Ceratioidea*.

After these first ceratioids from high latitudes were discovered, occasionally others were taken, usually only a single specimen, sometimes taken floating helplessly on the surface, as was *Melanocetus*

[1] Contribution Number 211. Woods Hole Oceanographic Institution.

[2] I am very much indebted to Dr. H. B. Bigelow, Director of the Woods Hole Oceanographic Institution, for many valuable suggestions made throughout the writing of this paper; it is a pleasure to thank him for his great assistance.

johnsonii Günther with another fish two or three times as long as itself coiled up in its stomach (Regan 1913). It was not, however, until the great oceanographic expeditions of the last fifty years or so that these peculiar fish were taken in any numbers. By far the most notable contributions to our knowledge of the *Ceratioidea* have come from the Danish oceanographic expeditions on the "Dana" under the leadership of Johannes Schmidt. The 1920–22 Expedition took more than three times as many specimens as had probably been caught altogether up to that time and more than doubled the number of known species (Regan 1925a, 1926), and the 1929–30 Voyage-around-the-world again more than doubled the described ceratioids (Regan and Trewavas 1932) bringing the total, including those more recently described by Parr (1934), Schultz (1934), Fraser-Brunner (1935), and Belloc (1938, p. 303–6) to one hundred and sixty-four species.[1]

Since about eight hundred and sixty specimens are recorded in the literature, this would average five specimens per species. The distribution of specimens has not, of course, been so fortunate, for two of the eleven families, twenty of the forty-one genera, and one hundred (or 61%) of the species are known from single specimens only. A mere handful of species are known from a sufficient number of specimens to allow any accurate ideas to be formed on their vertical and geographical distribution, changes in various parts and proportions in different stages of development, variability within the species, and many other such fundamental problems. There thus remains a tremendous amount of further collecting and comparative study of many more specimens before any adequate generalizations may be made concerning the biological relationships of these weird deep-sea fishes.

It was believed from an early date that the ceratioids were deep-sea fish, "degenerate" relatives of *Lophius piscatorius* L., living on the bottom with habits generally similar to those of this latter form. A species of Lophius common in the Mediterranean was well known to the ancients by such apt names as *βάτραχος ἁλιεύς*, Rana marina, Rana piscatrix, and the like. From the time of Aristotle vivid accounts were written of how this sly fish would use its frontal filament, or illicium, for attracting prey. The following passage (p. 67) from Oppian's "Halieutica," which was probably written in the reign of Marcus Aurelius (Emperor 161–180 A.D.), is an interesting example.

Most of the Renaissance ichthyologists, Rondelet, Belon, Salvianus and others, have passages describing similar behavior in Lophius. Ulyssi Aldrovandi in his "De Piscibus" (1612, p. 454–70) gives a non-

[1] *Oneirodes bulbosus* Chapman (Proc. U. S. Nat. Mus., Vol. 86, p. 538, 1939) brings the total up to one hundred and sixty-five.

critical but encyclopedic resumé of the earlier accounts of the matter. With the beginning of the "modern" scientific era, soon after the time of these men, such descriptions of the fishing frog's feeding habits were thrown into disrepute as being but entertaining fishermen's tales.

Hid in the Slime the *Toad* of Form uncouth
(That Fiſh is all one vaſt extended Mouth)
Her tender Body wraps, on Prey intent,
And ſilent there concerts the great Event.

What ſofter Skin, and flower Pace deny,
Wiſe Foreſight and ſucceſsful Frauds ſupply
Within her Jaws a fleſhy Fibre lies,
Whoſe Whiteneſs, grateful Scent, and Worm-like Size
Attract the Shoals, and charm their longing Eyes.
She to allure oft ſhakes the tempting Bait;
They eager preſs, and hurry on their Fate.
But as they near approach, with ſubtle Art
The wily *Toad* contracts th' inviting Part;
Till giddy Numbers thus decoy'd ſhe draws
Within the Circle of her widen'd Jaws.

The Fowler thus the feather'd Race deceives,
And ſtrows beneath his Snare the rifled Sheaves.
The buſy Flocks peck up the ſcatter'd Seed,
Nor midſt their Joy the fatal Engine heed;
Till with loud Clap the tilted Cover falls,
And the cloſe Pit the flutt'ring Prey enthralls.

(Translation of Diaper and Jones, Oxford 1722, lines 153ff.)

Much more recently, for example, Goode (1881, p. 469) considered that the dorsal tentacle of *Mancalias uranoscopus* (Murray) was more likely to be a sense organ for the detection of prey rather than an organ to attract it. This idea has had some confirmation from the work of Brauer (1908, S. 103), who found papillae which he considered to be

gustatory, since they were well supplied with nerve fibers, on the bait or esca of the frontal filament of Gigantactis. None the less, there would appear to be a considerable amount of truth in the old stories about Rana piscatrix since recent observations of this fish in its natural habitat such as those cited by Bigelow and Welsh (1925, p. 528) and those of Chadwick (1929) and Wilson (1937) on aquarium specimens indicate that a Lophius lying concealed on the bottom indeed often does lure other fish towards its waiting mouth by waving back and forth over its head the first dorsal spine with its terminal tag-like expansion.

This is undoubtedly true also of Antennarius, the frog-fish, another well-known shore water pediculate. Louis L. Mowbray, Esq., Director of the Bermuda Aquarium, has many times over a course of years observed the angling activities of aquarium specimens of this genus (personal communication 1938). When other small fish were placed in its tank, the Antennarius would slowly maneuver into a position near these other fish and begin to "angle." This consisted of moving about the rod-like first spine of the dorsal fin with its fleshy terminal expansion in a characteristic manner which was different in some cases for different kinds of prey. For example, when one kind of fish was in the tank with the Antennarius, it might slowly draw the first dorsal ray through the water in such a way that the "bait" moved back and forth in a sweeping arc, but when another kind of fish was present, it might vibrate the first dorsal ray and thus merely shake the "bait."[1] Any fish which ventured near the Antennarius to investigate the moving "bait" was drawn very quickly into the enormous mouth cavity of the frogfish by a sudden gulp.

Histrio, the closely related Sargassum fish, which has taken up the specialized habitat of floating Sargassum weed, has also been observed many times under similar conditions, but interestingly enough, this fish has never been seen to use its first dorsal ray as a lure for prey but appears rather to depend entirely in obtaining its food on stealth and its inconspicuous appearance, which resembles remarkably that of the Sargassum to which it clings.

Samuel Garman (1899) in his description of the *Pediculati* from the "Albatross" collection of deep-sea fishes introduced two useful terms in referring to the frontal filaments of the fishes in this order. The whole first dorsal ray with its terminal elaboration he called the illicium. This was a Latin word meaning lure or inducement; it was

[1] Wilson (1937, p. 488) similarly describes two comparable types of angling movements in Lophius.

not, however, at all frequently used by known Latin authors, and I have not been able to find it once used or referred to in any biological context earlier than Garman's, although a number of Latin authors used the related verb forms such as that seen in the quotation from Rondelet given below. According to Dr. Thomas Barbour (personal communication 1938), who was at the time a student in Garman's laboratory, Garman himself believed that he was coining a new biological term in illicium. Regan (1912), recognizing its usefulness, used the word again, and since that time it has been generally employed.

Garman called the terminal elaboration of the first dorsal ray the esca; this was a Latin word meaning bait, which had frequently been employed since classical times in reference to the use to which Lophius allegedly put its frontal filament. Cicero (ca. 45 B.C.) used esca in a description of the fishing frog's feeding habits in his "De Natura Deorum" (Lib. II, No. 125) ". . . ad quas quasi ad escam pisces quum accesserint . . .", and nearly all of the Renaissance natural history writers whom Needham has called the macro-iconographers of the sixteenth century, employed the same word similarly. Rondelet, for example, in his "De Piscibus Marinis" (1554, Lib. XII, Cap. XX) used it in the following passage concerning Lophius: " . . . ante (oculos) propendent appendices duae . . . quibus veluti esca pisces mira solertia allicit et capit quod non solum gravissimo Aristotelis testimonio, sed etiam piscatorum multorum experientia comprobatum est." It would seem obvious that Garman, who was a fine scholar of the old literature, had the term in question from such sources. Esca has not been used in recent ichthyological writings except by Garman, but I feel that the word would be a useful and convenient one to reintroduce.

Thus when Reinhardt (1837) described the illicium of Himantolophus as being the same as, but more highly developed than the fishing filaments of Antennarius and Lophius, he certainly implied its use as a lure. Lütken (1871), however, seems to have been the first to state this directly, and he even suggested that the shape of the esca and its tentacles in Oneirodes might resemble the head of a nereid worm. The fact that some parts of the esca in at least certain of the ceratioids were luminous was first mentioned by Willemoes-Suhm (1876) in his letters from the "Challenger." This luminescence was thought to make the esca effective in the "eternally dark abysses" of the oceans, where it could not otherwise be seen.

Brauer (1908) in the anatomical section of his classic work on the "Valdivia" deep-sea fish made histological studies of the illicium and

its terminal light organ in Gigantactis and Dolopichthys (which latter Brauer identified as Oneirodes). The light organ was described as a spherical, hollow, glandular structure located within the swelling of the esca and surrounded by a layer of reflecting cells and a heavy black pigment capsule. The lumen of the gland was filled by small granular bodies which Brauer considered to be secretory granules produced by the gland cells, some of which could be seen in his preparations breaking down and apparently releasing from their cytoplasm similar structures into the cavity of the organ. This lumen opened into a second, more distal cavity which in turn communicated with the exterior by a canal opening on the mid-dorsal line of the swelling of the esca. Because of its general structure and especially because of the presence of the external opening, Brauer believed this organ to be a "Spitzdrüse," that is a gland whose secretions were forcibly ejected. Never the less, he could not find any muscles in the esca which would permit such an active emptying of the gland's lumen. Neither was he able to find any nerve supplying the light organ although, as mentioned above, branches of an illicial nerve were distributed to the apparently sensory papillae of the esca. A fairly good blood supply, on the other hand, was found running to the luminous gland.

Similar terminal glandular organs may be present on other median fin rays of ceratioids such as those described by Brauer in the caruncles of the dorsal fin in Cryptosparas. As was noted by Regan (1926, p. 11) large specimens of this same genus may even have such structures present on the rays of the caudal fin. Luminescence has been observed by several workers to occur in the escal light organ, and Beebe (1934, p. 191–2) observed light coming from swellings on the tips of the first three dorsal rays in a ceratioid seen by him from the bathysphere; whether all such swellings on ceratioid fins are luminous or not is not known.

Dahlgren (1928) without more than merely stating that such was the case, described from histological examination the granules filling the cavity of the escal light organ of a specimen of Ceratias as luminous bacteria. He presumed that these organisms were living symbiotically within the esca, supplying light for the fish's bait in return for nutriment provided by a sort of culture medium maintained within the luminous gland by the activity of the secretory cells. A similar type of symbiosis had previously been described for the light organs of three or four other fishes, in some of which the results were quite convincing since careful bacteriological methods had been employed. (Dahlgren gave several references; see also Yasaki and Haneda 1936).

This same sort of interesting relationship has been found to occur in a number of luminous cephalopods. Bacteriological investigations of the light organs of a considerable number of different kinds of these animals (Kishitani 1932, Herfurth 1936) have shown that only in the case of luminous organs which open to the exterior by a canal or pore were symbiotic luminous bacteria present in large numbers; those light organs which were closed to the sea water did not contain the symbionts. The light organs of all the fish which were believed to cultivate luminous bacteria in their lumina were also open to the exterior. Dahlgren's conclusions concerning the bacterial origin of the light in Ceratias were thus in general agreement with such studies. However, in the case of another fish, the macrurid, *Malacocephalus laevis*, in which the light organ was open to the outside the luminescence was apparently not a bacterial luminescence since microscopic study demonstrated that the granules present in the material filling the lumen of the gland were not bacteria (Hickling 1925). Furthermore, the test for luciferin and luciferase,[1] "substances" known to be involved in the luminescent reaction of a number of different organisms was positive. These materials have never been convincingly detected in bacteria so that it would appear highly unlikely that they were being extracted from symbiotic luminous bacteria in this case. It is clear then that at least two methods of producing light are employed by fishes, and it is possible that combinations of the two may be found in the same animal, but only after many more, careful investigations of the various types of luminous fishes and their light organs will it be possible to draw any satisfactory general conclusions concerning these matters.

Several references in the earlier literature to cases where living ceratioids were examined in the dark, state that the light produced by the escal light organ was apparently under "voluntary" control; this meant at least that the luminescence was not continuous. In 1936 I had the opportunity to observe a living Dolopichthys which was taken by the research ship "Atlantis" in the Sargasso Sea. Still feebly moving this specimen was quickly removed from the net and placed in cold water. In the ship's dark-room, I was able to observe the luminescence of the escal light organ during the ten minutes or so that the fish remained alive. This remained dark until the fish was quite actively stimulated mechanically. When it did luminesce, the light was confined within the esca, which was transparent and more or less free from pigment

[1] See E. N. Harvey. 1935. Luciferase, the enzyme concerned in luminescence of living organisms. Ergeb. Enzymforsch. Bd. IV, S. 365-79.

distally, and no trace of luminous secretion was observed to be extruded from the external pore of the organ. The light was bluish green in color like that of the majority of luminous organisms and lasted for five or six seconds beginning dimly and rising to a peak in a second or so, maintaining the maximum intensity for several seconds, and then slowly fading out.

If the luminescence of ceratioids is a bacterial luminescence, the question of the control of the light is a very interesting one, for luminous bacteria under normal conditions luminesce continuously, unlike all animals which produce their own light. A simple method of control of the light of these symbiotic bacteria would be through the amount of oxygen available to the bacteria, which luminesce only under aerobic conditions. It is bacteriologically conceivable that anaerobic conditions could be easily developed within the lumen of the light organ which would, when they became completely anaerobic, extinguish the light entirely. Sufficient oxygen for luminescence (the amount necessary is extremely small as was shown, for example, by the experiment of Beijerinck (1902) in which sufficient oxygen for momentary luminescence of the previously dark bacteria was obtained in a suspension of clover leaves illuminated by the light of a single match) could easily be supplied by a blood system such a Brauer (1908) described in the ceratioids he studied. The present very imperfect state of our knowledge of the physiology of bioluminescence makes it unwise to do more than outline a few of the more salient points in this connection. Certainly the problem of the control of luminescence in animals is one of the least understood, yet biologically one of the most interesting of the many aspects of bioluminescence.

The nineteenth century students of ceratioids believed that these fish were benthonic, like Lophius. Filhol (1885, p. 81) even has an imaginative picture of *Melanocetus johnsonii* Günther in which several specimens are shown buried up to their eyes in the mud with their illicia waving over their heads. The fact that the mouth in this species opens upwards at a sharp angle made it a bit difficult to make these fish look plausible buried tail-downward in the ooze of the ocean bottom. Garman (1899) in his discussion of the genotype of Dolopichthys remarked on the improbability of such fish being active swimmers and stated his belief that their peculiar body form, fin reduction, and smooth skin were adaptations for life in the soft muds of the sea floor. It was Brauer (1906) who first showed that the ceratioids were bathypelagic rather than benthonic forms. He based his demonstration mainly on the analysis of vertical closing net hauls made by

the "Valdivia" and which showed at what depths in the water the specimens were fished; he furthermore pointed out that several ceratioids which had been taken previously had been found with scopeline and other non-benthonic fish in their stomachs. It is generally believed today that, with the exception of the young, which have often been taken in shallower water, the deep-sea angler-fishes live bathypelagically largely at depths ranging from 500–5,000 meters (Regan and Trewavas 1932, p. 12; Beebe 1937, p. 207).

The occurrence of dwarf males living attached to the relatively gigantic females which has been described in a number of deep-sea angler-fish is such a striking and bizarre phenomenon that it has become a part of everyday scientific knowledge. Nevertheless, no thoroughly satisfactory analysis of the few available facts concerning this interesting sexual relationship of the ceratioids has as yet been published. Regan and Trewavas (1932) give a good descriptive section on sexual dimorphism, however.

Saemundsson (1922) was the first to discover the attached males. He noticed two small fish grown fast to the belly of a large female *Ceratias holbölli;* he did not recognize them as dwarf males but thought that they might possibly be young of the same species since they showed certain well marked similarities to the larger fish. Three years later Regan (1925b) from a dissection of another specimen of *C. holbölli* to which a small fish was attached showed that this latter was a male with a fairly well developed testis and that the larger fish was a female.

Up to the present time fourteen specimens of these dwarf males have been discovered attached to twelve (out of the approximately five hundred and fifty known) female ceratioids. Most of these females had only one male grown onto them, but Saemundsson's specimen as mentioned above, had two, and one female of *Edriolychnus schmidti* (Regan and Trewavas 1932, plate IX, fig 2) had three of them. The males have been found attached head-on to the females by outgrowths from either the lower jaws or from both the upper and lower jaws to a papilla raised up on the surface of the body of the females. The place of attachment was apparently random since males have been found fastened to the belly, head, and even the preopercular spine of the females.

The female angler-fish so far found with attached males belong to four distinct families of the Sub-order *Ceratioidea.* Regan (1925, p. 397) at first believed that attached males were characteristic of the whole sub-order; this point of view was also favored by Parr. The latter worker, however, (1930) after a study of the anatomy of the

then rather anomalous family of ceratioids, the *Aceratiidae*, was led to conclude that these small fish, lacking an illicium externally at least (except for Anomalophryne Beebe, 1929) and generally possessing pincer-like rostral denticles, large nostrils and olfactory organs, were free-living stages of male ceratioids theretofore recognized only in the attached forms. A careful study of the viscera of one of these free-living non-illiciate fishes, *Rhynchoceratias longipinnis*, was made by Parr (1930). This specimen was indeed a male and had a testis apparently as large relatively as any found in the attached males which have been investigated in this respect. Determination of the sex of as many of the aceratiids as possible has led to the discovery that they were all males; furthermore, similar study has shown all the illiciate "typical" ceratioids to be females. From anatomical evidence it has been possible in most cases to assign the free-living males to families previously known only from females. Free-living males then have been found to occur in five of the eleven families of the *Ceratioidea*.

Parr (1930, 1932) suggested that the free-swimming males were doubtless merely at an earlier stage in their life history than were the attached males and would consequently become attached at some later time. On the other hand, Regan and Trewavas (1932, p. 20) thought it probable in view of Parr's discovery of the free-living males, that attached males occur only in the four families in which they had been found up to that time and that all the other families of ceratioids had free-living males. This point of view was not sustained by any direct evidence presented but seemed rather to rest on Regan's (1925b, p. 396) assumption which he had maintained from the beginning that the attached males became fastened to the females at an early stage, probably shortly after the larval stage, certainly before the gonads have matured.

Evidence for a long period of attachment at least was found (Regan and Trewavas 1932, p. 42) in the skull of an attached male *Ceratias holbölli* in which certain osteological peculiarities were believed to have resulted from the male's having been much smaller at the time of attachment. However, if Regan's original assumption corresponds to the facts then no free-living males with as well developed testes as Rhynchoceratias could be found in a family which had parasitic males. Yet free-living males have been found in the *Linophrynidae*. Thus the situation becomes rather confusing in the paragraphs concerning the male linophrynids (Regan and Trewavas 1932, p. 15ff) since both free-living and attached males are described in this family. The free-swimming males of the type of Aceratias were shown to be very similar

to the attached males of the Genus Borophryne. In spite of the fact that the free-living male *Linophrynidae* listed by Regan and Trewavas (1932) average over twenty-five percent longer in standard length than the attached males discussed, these authors felt obliged to maintain without qualification the assumption of an early time of attachment and the double hypothesis that free-living males occur in certain families of ceratioids and attached ones occur only in the remaining families. These views would seem to be rather troublesome to maintain especially since Parr's (1934, p. 56ff) discovery of a free swimming male, *Borophryne masculina,* belonging to a genus in which two females with attached males are already known. In this case, too, the free-living male is somewhat larger than the attached ones of the same genus.

It would thus seem clear that the simplest reasonable explanation of the facts would be that free-living and attached males might well be found to occur in all of the deep-sea angler-fish which have developed a marked sexual dimorphism. Furthermore, as Parr has pointed out (1930, p. 134), the males do not generally become attached at an early stage of their development since, for example, amongst the *Linophrynidae* mentioned above there are one hundred and thirty free-living males recorded in the literature and only eight attached males. The time of attachment and consequently the period during which this union of male and female lasts would appear from the evidence reviewed to vary with the individual circumstances.

It has been generally assumed that the development of males which were first free-swimming fairly active fishes and then sessile on the females was an adaptation to the fact that the female ceratioids were solitary sluggish animals whose chances of mating in the dark abysses of the oceans would be rather negligible if the males of the group were of similar habit. This adaptational point of view would go on to suggest that if a male and a female of the same species were so fortunate as to find one another, some means of their continued association until their reproductive functions had been discharged would be of great advantage. Thus it may be that certain of the individual males find and attach on to their mates soon after the post-larval period, whereas others swim about seeking mates until they have become mature, and doubtless still other males never do find a female of their species. Also it may be in the more primitive families of the sub-order, in which no attached males have yet been found, that instead of actually growing fast to the females, as was the case of the attached males already known, the males merely nip on to the females for a relatively short

period. The fact that only two percent of all the known female ceratioids and only seven percent of the females of just the families in which attached males have already described have males attached to them may be indicative of a relatively brief period of union between the two sexes. On the other hand, it may rather indicate, in conjunction with the very small size of the great majority of the angler-fish which have yet been captured, that only a relatively few mature fish have been taken so far.

Another point of interest concerning the male ceratioids is that although fifty-seven percent as many free-living male specimens as females have been found, there are only twenty percent as many species of males as there are female species. Thus there are not nearly enough species of males to pair them up with the females. If all the specimens which are assumed to be female are, it would seem likely then that either differences which were either individual or ontogenetic have been used in defining many of the female species, or else the ability to differentiate between males of different species has not been sufficiently developed to distinguish the rather obscure details which separate them.

The fact that both the *Melanocetidae* and the *Himantolophidae*, the most primitive familes of the *Ceratioidea*, have two genera of males to one of females has been pointed out by Regan and Trewavas (1932, p. 21) to be in striking contrast with the rest of the sub-order. The fish in one of the male genera in both cases, Centrocetus and Lipactis, were more like females in shape than any other known free-living males; teeth in the jaws, which were generally absent in male ceratioids, were present, and the rostral denticles were not well developed. The more typically ceratioid appearance and the very small size of these peculiar males would suggest the possibility that they were merely juvenile specimens. A minute male of the Family *Diceratiidae*, *Caranactis pumilus*, would presumably belong in the same category.

The physiological significance of the attachment of the males to the females in the deep-sea angler-fish is a point of great interest. Regan from his first paper on the subject has maintained that the attached males were nutritional parasites on the females. Sections cut through the region of attachment of the two fish were believed to demonstrate a complete blending of the vascular systems in that region indicating that they were continuous from one fish to the other (Regan 1926, p. 12). Furthermore, the mouth of the males, because of the nature of the attachment to the female, was no longer available for active feed-

ing, the stomach and gut were remarkably degenerate, and the union between the two was believed to last for a long time. All of these conditions would seem to indicate that the males must depend on some unusual source of nourishment. Further descriptions and figures of the region of fusion between the male and female, as it appeared in serial sections, were given by Regan and Trewavas (1932, p. 21); sinuses of the region were traced out as connecting the blood vessels of the pair through a capillary network on each side, thus proving the direct continuity of the blood streams that had been strongly suggested by previous studies. Parr (1930, 1932), however, expressed the opinion that the nutritional aspects of the continuity of the circulatory systems might not be as important as previously believed. He was led to this point of view, among other things, by the relatively enormous size of the liver in the specimen of free-living male whose anatomy he had investigated. Thus before the time of its attachment to the female, the male might store up a large quantity of food in its liver, which would be an efficient storage space; this food could then be used by the male during the period of his union with the female. Evidence in support of this suggestion may be obtained from a number of figures in Regan and Trewavas (1932, pp. 16, 17, 20, 22) of the visceral anatomy of male ceratioids. These figures show that the free-living males had relatively large livers whereas in the attached males which have been examined the livers were small. It is interesting to note in this connection that the attached male of *Ceratias holbölli* which Regan and Trewavas believed from osteological evidence to have been fastened to the female for a long period had apparently an extremely minute liver since this organ was neither shown in the figure of the anatomy of this fish nor mentioned in the text (Regan 1925b, fig. 4 and p. 392). Perhaps in cases where the attachment of the male lasts over a longer period than could be supplied with food stored in the liver, the nutritional possibilities of a confluence or even placenta-like arrangement of the blood streams may come to be realized.

A further structural arrangement pertinent to these matters has been known from the time of Saemundsson's (1922) discovery of the first attached male. Namely, the fact that in every case although the mouth of the attached fish becomes more or less occluded from the nature of the attachment, lateral openings into the mouth cavity are retained. These are believed to permit the circulation of a respiratory current. Regan (1926, p. 14) stated that since the attached males have a well developed heart and gills, they do not depend on the blood of the females for oxygen but only for nutritive materials. As Parr

(personal communication 1938) has pointed out, if arrangements for a respiratory current and normally developed respiratory and circulatory systems are maintained by the attached males, they could not be receiving sufficient oxygenated blood from the females for their own, probably meager, needs. Either then the male receives only venous blood from the female or else not much blood at all. Two facts would appear to cast some light on the probability of the former alternative: First, Regan (1926, p. 14) states that both arteries and veins run into the capillary network of the tissues connecting the males and the females. Second, if the males were carrying the added excretory burden of a considerable venous circulation from the females, unusually large kidneys might be expected in the attached males; these organs have not been found to be of greater size, however, than those found in the free-living males. If these arguments carry any weight, then we are left with the alternative that there is not much blood interchange between the males and the females.

One idea that has been suggested by both Regan and Parr is the possibility that the continuity of the blood streams would permit an hormonal interchange between the male and the female which might affect the differentiation of the gonads, and synchronize their maturation and the discharge of their sexual products. However, from the general results of vertebrate endocrinology, especially as related to parabiosis, it would appear unlikely that the attachment of the males, provided they were sexually differentiated (and there is no mention in the literature of any attached "male" in which the gonad could not be easily identified as testis) and normal as to their endocrine functions, was of any particular significance (Hisaw, personal communication 1938). It must be admitted, never the less, that in animals which have become morphologically as highly specialized as the ceratioids it would be difficult to predict with any degree of assurance what special physiological functions they may have developed in the course of their evolution.

The foregoing account has attempted to outline and assay the facts which are known concerning the deep-sea angler-fish. In the analysis of even the most recent knowledge of these fish the discussion has been filled with probabilities, suggestions, ideas, possibilities, and the like, and nearly every problem approached was found to rest in a highly unsettled and hypothetical state. This at the present time is true of our biological knowledge of all bathypelagic organisms. The great difficulty and expense of obtaining material and the well nigh insuperable barriers to experimental work in this field have been the

principal deterrents to great advances in these directions. It is to be hoped, however, that in the future with the further coöperation of the great oceanographic institutions and their research vessels that many of these intriguing and significant problems may be satisfactorily solved and fitted into the general body of physical and biological knowledge which constitutes the science of oceanography.

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II. Three new species

In the course of examining hauls made from the research ship "Atlantis" during the summers of 1936 and 1937 a few small *Ceratioidea* were found. Three of these are apparently new species belonging to 3 distinct families of this suborder: *Gigantactinidae, Linophrynidae,* and *Oneirodidae.*

Gigantactis longicirra, spec. nov. (Figs. 1 and 2)

1 specimen: holotype, M C. Z. No. 35,065.

Total length about 62 mm., standard length 39 mm. Illicium terminal on snout, length from articulation with basal bone to distal end of the bulb 15 mm. (39% of S. L.). Length of lower jaw 7 mm. (18% S. L.); eye diameter 0.8 mm. (2% S. L.).

Fin rays. D.8, A.6, C.8, P.18. Branchiostegal rays 6 (2+4); pectoral radials (pterygials) 5 (4+1).

Dentition. All teeth curved and depressable inward or backward. Lower jaw: 13–14 teeth on each side, of different sizes, ranged in 2 rows one within the other. Upper jaw: 8 in a single row on each premaxillary; maxillary toothless. Lower pharyngeals toothless; upper pharyngeals: 2nd and 3rd pharyngobranchials each have 3–4 large teeth. Palatines and vomer toothless.

The esca[1] (Fig. 2) consists of a somewhat pear-shaped swelling, rounded and blunt distally, and bearing at its proximal end 20 slender filaments which are 60–300% as long as the swelling itself. Each of these filaments terminates distally with a just perceptible bulbous expansion. Within the pear-shaped swelling is a heavily pigmented spherical core (the light organ) with a hemispherical prominence of about half its own diameter projecting from it postero-dorsally. The core is borne on the larger end of a conical expansion of the inner stalk which runs up the center of the illicial stem.

The nostrils are tubular; lateral line organs on projecting tags or flaps of pigmented skin are present on the head, body, and also the rays of the caudal fin. There are no channels or grooves connecting these organs with one another. The skin is closely set with small subcircular plates each bearing a short sharp spine.

No pelvic bones were found in a dissection of one side of the specimen.

[1] For definition and origin of this term and "illicium" see preceding section, p. 68–9.

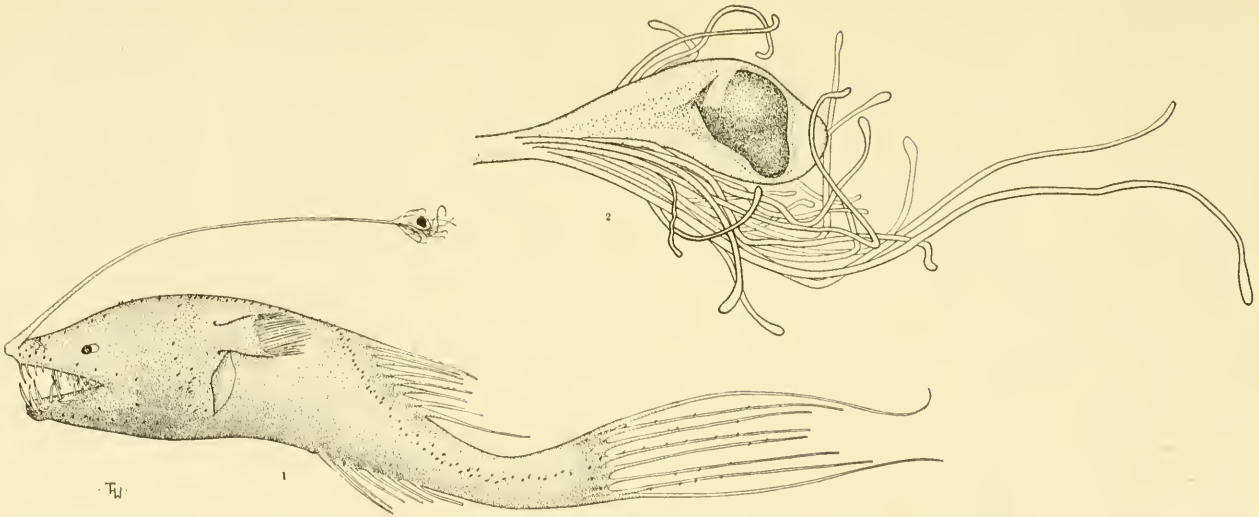

Fig. 1. *Gigantactis longicirra,* spec. nov. Standard length 39mm.
Fig. 2. Lateral view of esca of *Gigantactis longicirra,* spec. nov.

Color. Chocolate brown (after fixation in formalin, followed by alcohol.)

Type locality. "Atlantis" Station 2894, July 20th, 1937, continental slope about 300 miles east of Cape May, New Jersey (39°06′N., 70° 16′W.), closing net at 1000 m., 4 A.M., depth to bottom 2860 m.

Discussion

Clearly the slender, elongate body of this ceratioid, the attenuate frontal region of its skull, and the long illicium located terminally on the snout demonstrate that it belongs to the *Gigantactinidae* Boulenger, 1904, and more specifically to the genus Gigantactis Brauer, 1902. Of the 8 individual specimens of the genus, which have been taken previously, 7 are types of as many different species (Brauer, 1902; Regan, 1925, 1926; Regan and Trewavas, 1932; and Fraser-Brunner, 1935) from all of which the present specimen is notably distinct. Four characters clearly set it apart from any other known form. These are:

1. The number of dorsal rays is greater by 2 than that given for any of the other *Gigantactinidae;* all other members of the present genus have 6 and *Rhynchactis leptonema* 3 (Regan, 1925)[1].

2. In the pectoral appendage one more pectoral radial bone is present than has been described for any of the other *Pediculati,* which primitively have only 3 of these bones (Gregory and Conrad, 1936, p. 202). Regan and Trewavas (1932) have found 4 of these elongate basalia in both *G. sexfilis* and *Rhynchactis leptonema* and suggested (p. 25) that the presence of 4 of them is a diagnostic feature for the *Gigantactinidae.*

3. The length of the illicium from its proximal end, where it articulates with the modified pterygiophore or "basal bone," to the distal end of the bulb of the esca is less than 40% (38%) of the standard length. In previously known species, including smaller as well as larger specimens, this measure was always 60% or more of the standard length, varying from 60% in *G. exodon* (where it might be a juvenile character since the type is only 25 mm. in standard length) to 400% in *G. macronema.*

4. The esca is notably different from that described for any other ceratioid. Except for *exodon,* all other gigantactids have terminal filaments present on the esca whereas in the present fish there is no

[1] Only 5 dorsal rays are shown in the figure of *G. vanhoeffeni* although 6 is the number given in the description (Brauer, 1906).

trace of such. In *exodon*, however, the swelling of the esca tapers distally; this is definitely not the case with the new species. Yet in the only other species of Gigantactis, *orifer* and *filibulbosus*, in which the bulb does not taper distally there are two terminal filaments present in the esca and no proximal filaments at all. The proximal filaments of the new species' esca are more numerous and longer proportionately than any such filaments found in other specimens of Gigantactis.

A further point of interest in *G. longicirra* concerns the lateral line organs. In other members of the family (Regan and Trewavas, 1932, p. 24) these occur on "stalks" rather than on "tags" as found in *longicirra*. If this difference does not depend on confusion of terminology it may well be a fifth clear distinction of the present species. Brauer (1906) figures *G. vanhoeffeni* with lateral line organs on the caudal rays much as in *longicirra* but does not mention this unusual phenomenon in the text.

Although the standard length of the present specimen is only 40% of that of the largest specimen of Gigantactis yet taken (the type of *G. macronema* Regan, 1925), one half of the types of previously known gigantactinids are smaller. Thus it would appear that the characters used to distinguish *G. longicirra* are no more likely to be juvenile than are those for half the members of the genus. Furthermore, it would not seem likely that the structural characteristics listed above (at least the first two) had been derived by growth or simplification as a stage in the life history of some previously known form. However, in the absence of any direct evidence concerning the changes which take place in Gigantactis in the course of its ontogeny, it is rather difficult to make any predictions concerning such aberrant forms.[1]

Linophryne algibarbata, spec. nov. (Figs. 3 and 4)

1 specimen; holotype, M. C. Z. No. 35,066.

Total length 40 mm., standard length 28 mm. Illicium suprarostral, length from articulation with basal bone to distal end of bulb 7 mm. (25% of S. L.), basal bone not exserted in present condition of specimen.[2] Bulb of esca 50% of length of illicial stem. Length of lower

[1] But see Fraser-Brunner's (1935) suggestion that the presence of teeth on the lower jaw well down on the sides of the chin and away from the bite of the jaws was a juvenile character in Gigantactis.

[2] Since the basal bone (modified pterygiophore) of the illicium is freely moveable and supplied among others with extensor and retractor muscles, the amount of its exsertion in any specimen depends on the condition of these muscles on fixation. Clearly, however, certain forms such as Mancalias and Lasiognathus must always have a considerable portion of the basal bone exserted whereas others as Edriolychnus and Himantolophus do not.

Fig. 3. *Linophryne algibarbata*, spec. nov. Standard length 28mm.

jaw to articular spine 9 mm. (31% S. L.). Barbel length about 24 mm. (86% S. L.).

Sphenotic and preopercular spines large and sharp, free of skin except at their bases, smaller frontal and articular spines present.

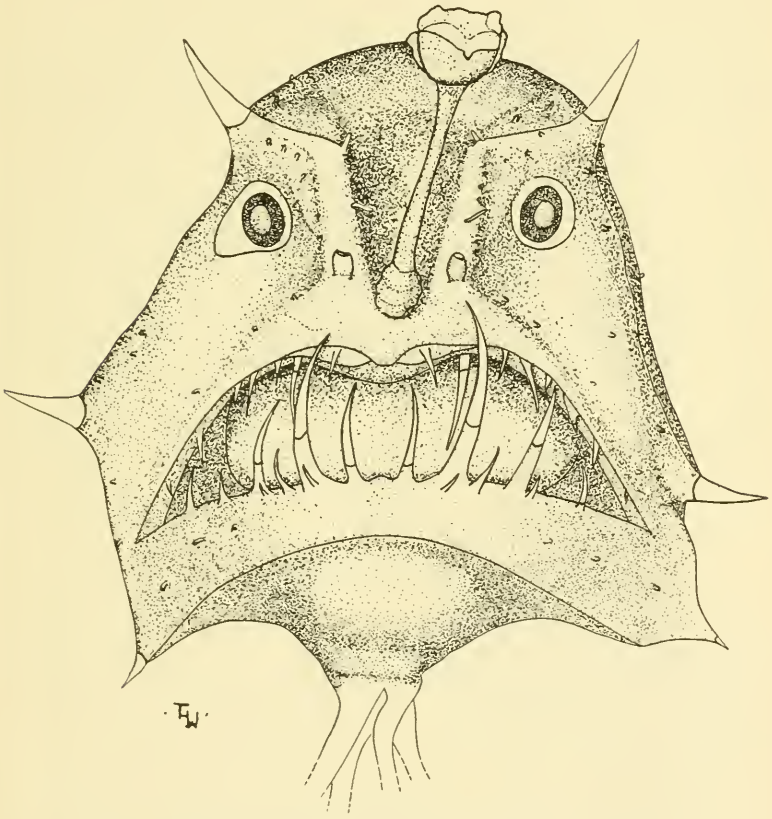

Fig. 4. *Linophryne algibarbata*, spec. nov.

Dentition. Teeth depressable inwards. Lower jaw: 7–8 irregularly arranged teeth including 1 very large (15% S. L.) and 2 smaller fangs on each side. Upper jaw: 7–8 irregularly arranged teeth including 1 large fang on each premaxillary; maxillary toothless. Large fangs saber-like, sheathed proximally in pigmented epithelium. Lower

pharyngeals toothless, 3 teeth each on second and third upper pharyngeals (pharyngobranchials). Palatines toothless; 2 teeth on vomer.

Fin rays. D.3, A.2, P.16. Brachiostegal rays 4 (1+3); pectoral radials (pterygials) 3 (2+1). Pigmented skin runs out over all fin rays.

Barbel arises from short stalk which divides immediately into four main branches of approximately equal length and diameter; each of these gives rise to irregularly arranged, much shorter secondary and tertiary branches, which in most cases have knob-like swellings along their lengths and terminally.

Esca consists of a subspherical bulb bearing around its anterodorsal surface a roughly horse-shore shaped ridge which consists of a median and two lateral lobes. In the median line, just posterior to this ridge is a low silvery papilla behind which is the external pore of the luminous organ of the esca. A slight longitudinal ridge of short extent is present immediately posterior to this. A black pigment cup which is visible through the transparent outer layers of the bulb surrounds about half of an inner sphere (the light organ), the exposed, distal part of which appears silvery. The rim of this pigmented cup has two distinct notches in it, one anterior, which is visible in Fig. 4, and one posterior.

The nostrils are large and tubular; lateral line organs are present on the head and body; these are situated on tags of pigmented skin, a few of which are notably larger than the rest. No channels or grooves connect these organs.

No pelvic bones were found in a dissection of one side of the specimen.

The skin is smooth and (after fixation in formalin followed by alcohol) chocolate brown in color.

Type locality. 39°06′N., 70°16′W., July 20th, 1937; closing net, 400 m., 5 A.M., depth to bottom 2860 m.

Discussion

In recent papers Regan and Trewavas (1932) and especially Parr (1934) have organized and extended our knowledge of the genus Linophryne. Twenty-five specimens belonging to this genus have been reported in the literature. For the twenty-one of these which are adequately known thirteen species and five subspecies have been defined. Thus nine species and two subspecies are known only from single specimens. In no case has more than one fish of a species in this genus been taken in a single catch.

The characteristics which distinguish *L. algibarbata* most clearly from any of these previously known species are as follows:

1. The absence of either terminal or lateral filaments or of digitiform appendages on the esca. These occur in all other known species in some form or combination.

2. The general pattern and the method of branching of the hyoid barbel. While this appendage is similar in a general way to that of *L. arborifera* and of *L. macrodon*, it differs distinctly from these not only in the fact that the four main branches are of approximately equal length and diameter but also in the details of the secondary and tertiary ramifications.

3. Presence of only 4 branchiostegal rays instead of the 5 which Regan and Trewavas (1932) had concluded from their dissections of *L. racemifera*, *Halpophryne sp.*, and *Aceratias indicus* were characteristic of the Family *Linophrynidae*. However, the present observation shows that more specimens will have to be investigated before the significance of this point for diagnostic purposes will be apparent.

Since the present specimen differs from forms previously described in the fundamental pattern of the barbel and of the terminal appendages of the esca, it is clear that a new species is necessary here rather than a subspecies, such as those set up in *Linophryne arborifera* and *L. coronata* by Parr (1934) on the basis of minor variations in the details of these structures.

Dolopichthys albifilosa, spec. nov. (Figs. 5 and 6).

1 specimen; holotype, M. C. Z. No. 35,067.

Total length 45 mm., standard length 33 mm. Illicium suprafrontal, length from articulation with basal bone to distal end of escal bulb 14 mm. (41% S. L. or 2.4 times as long as the exserted part of the basal bone in the present condition of the specimen[1]). Bulb of esca about 20% of length of illicium from basal bone articulation. Length of lower jaw 14 mm. (41% S. L.); lower jaw with symphysial spine. Large sharp sphenotic spines present; also 2 articular spines on each side, less than half the size of the sphenotics.

Fin rays. D.5, A.5, P.17. Branchiostegal rays 6 (2+4); pectoral radials (pterygials) 3 (1+2).

Dentition. Teeth slender and acicular, depressable inwards. Lower jaw: 24 teeth on each side arranged in three series of different sizes. Upper jaw: 24 in a single series on each premaxillary (only 7–8 of these evident without partial dissection); maxillary toothless. Up-

[1] See footnote 2, p. 85.

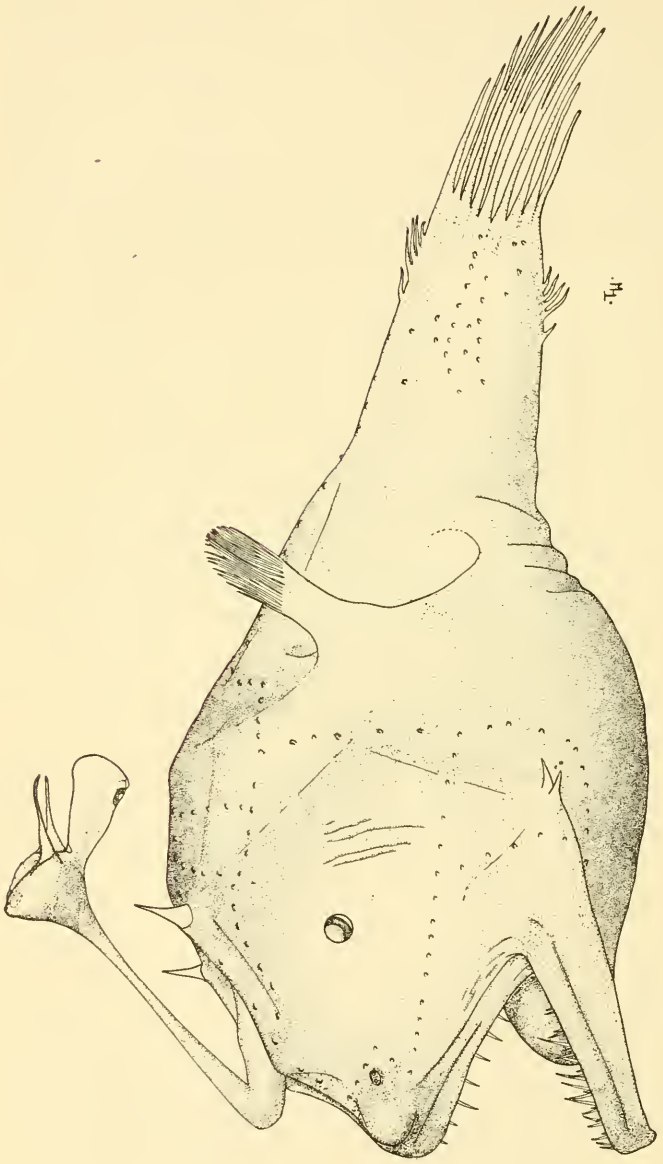

Fig. 5. *Dolopichthys albifilosa*, spec. nov. Standard length 33 mm.

per and lower pharyngeals and palatines toothless. Two teeth on each side of vomer.

The esca[1] (Fig. 6) consists of a laterally compressed terminal expansion of the illicium enclosing within it an ovoid bulb. On the median anterior aspect of the latter is a low papilla projecting anterodorsally. Just posterior to this and running laterally are two slightly raised areas; between these and in the median line is a ridge which runs posteriorly and bifurcates over the posterior portion of the bulb. Each limb of this bifurcation gives rise to a stout, rapidly tapering filament one-fourth as long as the illicium from basal bone articulation to distal end of bulb. A loose transparent layer of tissue covers the distal part

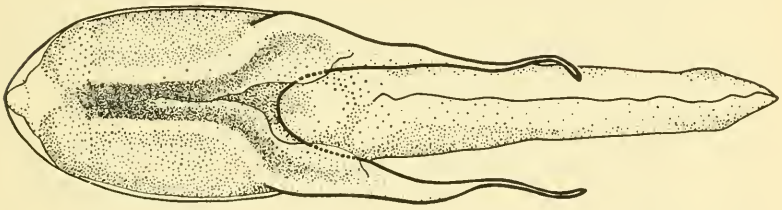

Fig. 6. Dorsal view of esca of *Dolopichthys albifilosa*, spec. nov.

of the bulb and terminates posteriorly in a little upstanding ruffle on the antero-median surface of each of the escal filaments. Posterior to the latter and in the median sagittal plane the escal bulb bears a large vane-like, laterally compressed appendage three-tenths as long as the illicium. Distally on the ventral margin of this appendage there is a subspherical heavily pigmented body with a ventrally directed white spot (light organ?). The remaining pigmentation of the whole structure is as follows: the inner bulb of the esca, the proximal part of the latter where it expands from the illicial stem, and the median ridge running posteriorly from the papilla, are all heavily pigmented. The two raised areas just behind and lateral to the papilla, the ventral part of the compressed appendage and the anteromedian aspect of the escal filaments are lightly pigmented by a few scattered granules. The remaining parts of the esca including the rest of the two filaments are whitish.

The nostrils are short and tubular with two openings distally; lateral

[1] The present description of the esca is made with the orientation of this organ in the living animal in mind. "Posterior" and "anterior" are reversed in relation to Regan and Trewavas' (1932) use of these terms.

line organs on tags or flaps of pigmented skin with terminal white spots are present on the head and body. An unusual aggregation of these organs occurs caudally between the opposed soft dorsal and anal fins.

A pelvic bone was found in a dissection of one side of the specimen.

The skin is smooth and jet black.

Type locality. "Atlantis" Station 2667 (35°40′N., 69°36′W.), depth of haul unknown, September 1936.

Discussion

It is clear that the present specimen is closely related to *Dolopichthys nigrifilis* Regan and Trewavas (1932, p. 67). There are, however, a number of distinct differences between them:

1. The escal filaments of *D. albifilosa* are almost entirely free of pigment, whereas the proximal four-fifths of the same appendages in *nigrifilis* are heavily pigmented.[1]

2. These same filaments in the new species are only one-fourth of the length of the illicium from basal bone-articulation to distal end of the bulb; in *nigrifilis* they are about one-half this length or relatively twice as long.

3. In *albifilosa* the stalk of the illicium is heavily pigmented and this pigment runs out distally so far that it covers one-half of the terminal expansion containing the illicial bulb. In *nigrifilis* neither the illicial stalk nor its terminal expansion are so pigmented (Regan and Trewavas, 1932, Fig. 92).

4. The compressed escal appendage in *albifilosa* is somewhat longer relative to the length of the illicium and it is rather more lightly pigmented than it is in *nigrifilis*.

5. The illicium is only 40% rather than 50% of the standard length in the new species.

6. In the present specimen the illicium distal to the basal bone-articulation is only 2.5 times the length of the exserted part of the pterygiophore whereas in *nigrifilis* it is six times this length (see, however, footnote 2, p. 85).

7. The cleft of the mouth in *albifilosa* does not extend posteriorly to the level of the eye whereas it extends behind the eye in Regan and Trewavas' (1932) specimen of *nigrifilis*.

[1] It is worth pointing out that the type specimen of *D. albifilosa* was so little damaged when it arrived on deck that it lived for a short time in chilled sea water (see preceding section, p. 71); presumably then such an absence of pigment as mentioned above may well be considered natural rather than due to damage in capturing the specimen.

8. The dentition of the two species would appear to be significantly different; *albifilosa* has 60% more teeth in the upper jaws, and 30% more in the lower than *nigrifilis*. This fact is difficult to evaluate since we do not as yet have any data on the individual or ontogenetic differences in the teeth of ceratioids.[1]

9. The only known specimen of *nigrifilis* is from the China Sea (19°18.5′N.,120°13′E.) whereas *albifilosa* is from the western Atlantic.

The above differences which distinguish the new species from its nearest relative are thus seen to be rather small, and when considered separately some of them are of questionable importance. Nevertheless, they are of the same order of magnitude as those which have been used to establish a great many of the species of this genus (compare, for example, *D. ptilotus*, *D. multifilis*, and *D. claviger* Regan and Trewavas, 1932, p. 73). From the ninety-three specimens of Dolopichthys which have been taken forty-six species have been described; twenty-nine (63%) of them are monotypic. The distinctions between the various members of the genus are, however, of two principal orders of magnitude so that Regan and Trewavas (1932) have distinguished between these by grouping certain of the species differing inter se by such characters as minor variations in the escal pattern into five subgenera which are characterized by differences of a more fundamental nature.[2] In spite of the small amount of material available for comparative study and in spite of the slight variations which have been used in establishing many species, from their wide experience Regan and Trewavas (1932, p. 71) feel that most of the species will prove in the future to be valid.

In view of these facts the establishment of a new species for the present specimen would seem to be quite in keeping with the precedent for the genus.

[1] See Fraser-Brunner, 1935, for discussion of evidence for possible ontogenetic changes in the dentition of Gigantactis.

[2] Parr (1934, p. 41ff.) in his revision of the genus Linophryne has accomplished the same sort of distinction between the relative importance of characters by the alternative method of setting up sub-species.

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THE LEPIDOPTERA OF BARRO COLORADO ISLAND, PANAMA

By William T. M. Forbes
Cornell University, Ithaca, New York

With Eight Plates

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
August, 1939

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OF THE

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A. *Euchromiidæ, Nolidæ, Arctiidæ, Pericopidæ*

The material of this report should give a fair sample of the fauna of Barro Colorado Island, and is presented to put the new data on record, but also to serve as a basis for other studies, biological and the like, which may be made there. It is based on collections made all through the year except for a short gap in the latter part of August and September, but more systematically in November to February, 1934–35, when Dr. Marston Bates was collecting continuously and intensively, and in February and March of 1936, when a group of the staff of the American Museum of Natural History worked there. While many more species will certainly be taken, especially those whose main flight periods come in the summer, it is probable that all the really dominant species are included, and that except for midsummer, few of the more conspicuous forms are omitted.

The great mass of the material is in the Museum of Comparative Zoölogy. The American Museum has the lot collected in Feb.–Mar., 1936, by F. E. Lutz, W. J. Gertsch and Wm. C. Wood, and a few collected by C. H. Curran in 1935, and Cornell a few collected by J. C. Bradley in Mar.–Apr. 1924. The principal collectors for the Museum of Comparative Zoölogy were Dr. Bates, Mr. A. Friedman in the early summer of 1935, Graham Fairchild in the summer of 1923, and Nathan Banks in the summer of 1924; the last two contributing relatively few specimens but giving us our only knowledge of the summer fauna.

Another lot that has been mentioned and included in the keys is that taken by Mr. August Busck in the part of the Canal Zone which has since been flooded, in 1911–12. So far as this fauna survives it must have taken refuge on Barro Colorado Island, and a few more limited areas. The records were published by Dyar[1], and a few more have been added which were identified or described more recently from the same lot, in most cases by Dr. William Schaus.

For the sake of compactness, collectors' names will be cited specifically only in records of unusual character, and all records not otherwise credited are to be assumed as referring to Barro Colorado material, now in the Museum of Comparative Zoölogy. Duplicates

[1] Proc. U. S. Nat. Mus. xlvii, 1–67 (Busck), 139–350 (Dyar); 1914.

of most of the species will be deposited in the Cornell University Collection.

The four families discussed here form a homogeneous group, closely related to the Noctuidæ, with which they share the "quadrifid" venation and the thoracic tympanum. Larval characters would indicate that the Nolidæ are directly derived from the Noctuidæ (Sarrothripinæ), but that the others are of a parallel stock arising from the Hypsidæ.

The get-up of the paper is designed to be convenient for those intending to identify material as a basis for biological studies; so brief keys are included of the species actually taken on the Island, and those included in the National Museum survey; and the bibliographic citations emphasize the published figures.

The following are the principal works on the area:

Druce, H.: Biologia Centrali-Americana, Lepidoptera-Heterocera. 2 vols. text and one of plates (abbreviated in the citations of figures as "Biol." with plate and figure numbers).

Hampson, G. F.: Catalogue of the Lepidoptera Phalænæ, i and Supplement i (Euchromiidæ as Syntomidæ or Amatidæ), ii and suppl. i (Nolidæ; Lithosiinæ), iii and suppl. ii (Arctiinæ); (abbreviated "Hamps." and "Hamps. Suppl." with plate and figure).

Seitz, A.: Macrolepidoptera of the World *or* Grosschmetterlinge der Erde; vi, Euchromiidæ, Nolidæ and Lithosiinæ by M. Draudt, Arctiinæ by Seitz, Pericopidæ by M. Hering; (abbreviated "Seitz" with plate, line, and figure counting from the left).

Rothschild, Walter: Novitates Zoologicæ xvii, 1–85, 113–171, 1910 (giving fuller distributions of many species).

Dyar, H. G.: Proc. U. S. National Museum xlvii, 139, 1914, (giving further Canal Zone data for many species).[1]

In the case of the first three works the numerous figures are cited very briefly;—other figures referred to are cited sufficiently fully to lead directly to their location. In general the figures in Seitz are copies of the others, and frequently have lost something in copying. It also figures a few species described since Hampson's supplements.

Where descriptions of early stages have been noted they are cited in the bibliographies, and summarized in the text, but otherwise the

[1] Rothschild has also published a series of papers on these families supplementary to Hampson's Catalogues. The principal ones are Nov. Zoöl. xvi, 21–55, 268–299, pls. 4–7; xvii, 172–188, 429–445, 504–506, pls. 11–14; xviii, 24–45, 154–158, pls. 3–6; xix, 151–186, 212–246, pls. 3–5; xx, 192–226, pls. 13, 14.

bibliography is cut to the original description, reference to important or convenient figures, and new or obscure synonymy. A somewhat more complete bibliography will be found in the Lepidopterorum Catalogus, fascicles vii (Syntomidæ, i.e. Euchromiidæ, by Zerny, 1912), xxii (Arctiinæ by Strand, 1919), xxiv (Nolidæ by Strand, 1920), xxvi (Lithosiinæ by Strand, 1922) and xlv (Pericopidæ by Bryk, 1931).

Dates for the commoner species are presented in tabular form at the heads of the families Euchromiidæ and Arctiidæ,—those of rarer forms are included in the text.

EUCHROMIIDÆ

(Syntomidæ; Amatidæ; Zygænidæ of earlier authors)

Head with strong palpi and tongue and conspicuous ocelli; thorax with tympanum below base of hind wing (vestigial in the Old World types), protected by a hood developed from the first segment of the abdomen above the spiracle; fore wing with apparently 4-branched Cu (except a few species which have lost M_2); hind wing relatively small, Sc normally absent, in some primitive species visible as a short spur from upper side of cell beyond middle. Larva with a single large subdorsal wart each on meso- and metathorax; with feathery tufted hair and usually pencils, which are most often lateral on first and 8th segments of abdomen. Pupa fusiform, without cremaster or flange-plates on sides of abdomen, with antennæ and tongue extending to tips of wings; glossy.

The absence of Sc will separate this family as a rule from the Arctiidæ, but in Eucereon, Episcepsis, Aclytia and Hyaleucerea there are species with Sc preserved, while many Phegopterine Arctiidæ have Sc more or less aborted, and a few have lost it entirely. The Euchromiidæ, unlike the Arctiidæ, are almost always heavily pigmented forms with brown or black veins, while most of the Arctiidæ are lightly pigmented night-flyers. The Belemnia group would be an exception but should probably be transferred to the Euchromiidæ.

I should divide the family into three subfamilies. The *Amatinæ* are limited to the Old World, and all save a few primitive African types (Pseudapiconoma, Melisa and Phæosphecia) have fused R and M_1, so that the hind wing has only a single vein from the upper angle of the cell. In the *Euchromiinæ* M_2 of the hind wing is rudimentary or absent, being represented by a faint vein or line of scales from the angle of the discocellular, and Cu_1 and Cu_2 are stalked or united; while in the *Ctenu-*

chinæ M_2 is fully developed and curved, arising from below the angle of the discocellulars, and Cu_1 and Cu_2 are widely separated except in the Horama group. A few aberrant genera also have M_2 obsolescent from the angle but Cu_2 well separated. I believe these are aberrant Ctenuchinæ, but none have yet been taken on Barro Colorado Id. The two latter subfamilies are New-world, except the single genus Euchromia; and the Nearctic species are all Ctenuchinæ, one or two Euchromiinæ reaching north to Georgia.

The diagram opposite records the dates of capture of the commoner species, as represented in the collections of the Museum of Comparative Zoölogy. Each column represent a quarter of a month. Where a single specimen was taken it is indicated by an open circle (o), if more than one by a solid spot (●). In the case of Fairchild's specimens, which were not individually dated, records are indicated by a line covering the proper period, and the number of specimens. Except for such of these as may have been taken in early August, August and September are vacant. Dyar (l.c.) gives further regional dates.

Key to Genera of Euchromiidæ

1. Hind wing with Cu_1 and Cu_2 stalked or united, in the latter case the hind wing with only three dorsal veins, and the two lower (which are M_3 and Cu_{1+2}) arising closer together than to M_2, or with only two dorsal veins, M_2 being a rudimentary fold or line of scales extending from the angle of the discocellular (*Euchromiinæ* and *Horama* group)[1] 2

   Hind wing with Cu_2 widely separated; M_2 and M_3 sometimes united, in which case the two most dorsal veins (Cu_1 and Cu_2) are well separated and the upper (M_{2+3} and Cu_1) are close together or stalked, never with only two dorsal veins (*Ctenuchinæ*) 22

2. Upper of the three veins (M_2) separated by a distinct space from the stem of the other two at origin 3

   Upper of the three veins (normally M_3) connate or short-stalked with the stem of the other two at origin 4

3. Head and prothorax densely hairy . . . . . *Amycles*

   Head and prothorax smoothly scaled . . . . . *Ceramidia*

[1] In the Euchromiinæ there are only 3 veins by the obsolescence of M_2; in the members of the Horama group which have been reported from the Zone there are only 3 veins by the complete union of Cu_1 and Cu_2, in Horama itself, which is regional, Cu_1 and Cu_2 are forked toward the margin.

NAME	Month	Jan.				Feb.				Mar.				Apr.				May				June				July				Aug.				Oct.				Nov.				Dec.				Total
	Week	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	4	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
P. aliena		●	○	●		●	●	●	●		○																													○			●	30
H. stictosoma		○		○	●	●	●	○	●		○	○		●	○											.	.	.	1	.	.	.				○				●	●		●	47
G. salvini		○			●	●	●	●	●	●	●	●						○	○	○		○	○	●	○	.	.	.	7	.	.	.		●		●		●	●	●	○	●	●	●	●	103
G. colona		●			●	●	●	●	●	●	●	●		●	○				○														○	○	○						●	●	●	●	55
P. paucipuncta			○		○	○	○		○	●	●	●	●	●	●	○		○								.	.	.	25	.	.	.					●				○		●	●	65
M. pyrrha		○			●	○	●			○	○															.	.	.	1	.	.	.						○	○				○	23
M. ethela		●			○	○	●	●		○	○			●																														20
C. echemus		●		●	●	●	●	●	○		●				○	○																		●		○	●	●	●		●	●	●	63
C. tabascensis					○																					.	.	.	1	.	.	.				○	○		○		●	●	○	13
C. saron		●	○		●	○	●	○	●	●					○										●																		22
C. metallescens		○	●	●	●	●	●	●	●	○	●	○		●		○				○		○	○			.	.	.	4	.	.	.						●	○			●		●	67
C. hercynacula		○			●	●	●	○			○			○			○									.	.	.	11	.	.	.				○			○				●	40
S. clusia						○	○	○			●																																	23
S. nox		●	○		○		○							○	○											.	.	.	1	.	.	.		●	●		○				○		●	●	45
S. phœnicosticta		●	●		●	●	●	●			●	●			○										○															○	●	●	●	51
S. anselma				●	●	○	●	●	○				○							○																								22
S. afflicta			○	○		●	●																																			●	●	17
P. thoracica		○	○			●	●	●	●	●	●	●	○	●	○	●	●	○		○		○		○	○	.	.	.	2	.	.	.						●	○		○			○	65
D. correbioides				○	○	○	○				○			○												.	.	.	1	.	.	.												10
M. auripes		○			○	●	○	○								●										.	.	.	1	.	.	.											○	9
M. cyllarus		○	○		○	○				○	○		○				○								●												○			●				13
C. tiburtus				●		●		○	●	●	○	●			●			○				○			●																	●	50
M. achrysa							○				○							○		○		○		○													○	○						9
H. restricta		○		●	●	●	●	○		○	●			●				○																		○	○			●	●			26
Ec. obscurata		○	○		●									○																						○	○	●			○		●	16
D. rubricincta		●			○	○		●	○		●			○				○		○														○		●		○	●	●	●	●	●	33
Eu. obscurum		○		○	●	●				○	○	○	○	○				○																		○	●	○	○	●	○	○	●	26
C. affinis					●	○	○				○					○					○					.	.	.	2	.	.	.						○			○		●	●	16
C. e. germana		○		●	●	○									○											.	.	.	1	.	.	.		○		●		●	○	●	●	●	●	●	●	49
C. e. costinotata				○	○	●	●							○																				○	○	●	●	○	●	●	○	○	●	●	28
C. e. elegans					○	●	○	●																		.	.	.	1	.	.	.				●	○	○	○				●	○	15
C. e. striata							○																											○							○	○			4

4. Fore wing with R_1 and $_2$ stalked (normally arising out of the base of R_{3-5}) 5
   Fore wing with R_2 stalked with R_{3-5}, R_1 separate 6
   R_2 arising separately from cell 21
5. Wings with transparent spots or areas . . . . . *Leucopleura*
   Wings opaque and evenly scaled . . . . . *Psoloptera*
6. Abdomen with small divergent sublateral tufts on last segment; the Barro Colorado species markedly constricted at third segment . . . . . *Phœnicoprocta*
   Abdomen without lateral tufts on last segment, the abdomen constricted at second segment if at all 7
7. Second segment of abdomen narrowed by a slight notch in front, abruptly widened behind, wasp-like . . . . . *Pompiliodes*
   Second segment of abdomen not constricted 8
8. Antenna with middle part of shaft considerably widened as compared with its base, especially in female 9
   Antenna with shaft not widened, or in female with middle of shaft a little wider than extreme base 13
9. Disc of thorax with considerable long hair . . . . . *Homœocera*
   Thorax with long hair only on edges of tegulæ etc., mostly close-scaled 10
10. Hind tibiæ toward end and tarsi fringed with long scales, at least above; blade-like . . . . . *Macrocneme*
    Hind tibiæ with the usual close scaling 11
11. Hind wing with lower part of cell very short, reaching only about 1/3 way to apex of wing; wings transparent . . . . . *Isanthreme*
    Hind wing with lower side of cell longer, reaching almost half length of wing 12
12. Cu_1 of fore wing arising almost half way between M_3 and Cu_2 *Dycladia*
    Cu_1 of fore wing arising about ¼ as far from M_3 as from Cu_2 *Autochloris* (*Bombyliodes*)
13. Fore wing with M_2 leaving cell well above origin of M_3 14
    M_2 and $_3$ closely approximate or connate at origin 15
14. Hind wing with lower discocellular very short, obsolescent *Loxophlebia*
    Hind wing with lower discocellular a fifth as long as middle one *Mesothen*
15. Hind wing with lower discocellular obsolescent, about 1/10 as long as middle; lower side of cell less than ¼ length of wing . . . *Pheia*

Hind wing with lower discocellular about 1/6 as long as middle or longer; cell more than ¼ length of wing 16

16. Fore wing with R_1 stalked on R_{2-5}; cell of hind wing moderate with lower discocellular moderately long, and M_3 and Cu_1 moderately stalked . . . . . *Chrostosoma*

Fore wing with R_1 arising separately from cell 17

17. Hind wing with M_3 and Cu_1 strongly stalked, 1/3 or more of the distance from end of cell to margin 18

Hind wing with M_3 and Cu_1 connate or barely stalked . . . *Saurita*

18. Thorax densely hairy, except patches on the collar and sometimes shoulders, which are smoothly scaled . . . . . *Sarosa*

Thorax with at least large areas on tegulæ and disc closely scaled as well as collar, frequently with only fringes of long hair on tegulæ etc 19

19. Wings solidly scaled, at most with small transparent streaks on basal part of fore wing and base and disc of hind wing. *Rhynchopyga*

Wings largely transparent, usually less elongate 20

20. Outer margin of hind wing evenly rounded or nearly so (sometimes somewhat lobed in small species with dominantly yellow bodies). *Cosmosoma*

Outer margin of hind wing with anal lobe separated by a distinct notch; abdomen dominantly dark with blue spots; thorax normally more hairy . . . . . *Gymnelia*

21. Fore wing with M_2 and M_3 closely parallel about ¼ way to margin, then divergent; hind tibia but slightly flattened and not fringed *Calonotos*

Fore wing with M_2 and M_3 immediately divergent; hind tibiæ and tarsi with strong fringes of hair-scales above . . *Macrocneme* (part)

22. Both wings with a dorsal vein absent (M_2 and M_3 united); small wasp-like species with transparent wings . . . . . *Syntrichura*

Fore wings with all dorsal veins present 23

23. Hind wing with a dorsal veing absent 24

Both wings with all veins present 27

24. Wings opaque or with small translucent spots; abdomen simple; hind wing with cell normal and the interspace between M_{2+3} and Cu_1 twice as long as wide . . . . . *Delphyre*

Wings broadly translucent or transparent; abdomen with lateral tufts on terminal segment 25

25. Wings perfectly hyaline (with black markings); cell of hind wing normal, abdomen with a pair of lateral tufts on last segment *Metastatia*

Cell of hind wing very long, the interspace between veins M_{2+3} and Cu_1 about as wide as long 26

26. Wings hyaline; abdomen constricted on third segment but continuing narrow, and not specially marked there; abdomen with only anal tufts ..... *Chrysostola*

Wings translucent; abdomen strongly constricted at third segment and with white spots, making it seem even more slender; with lateral as well as anal tufts ..... *Eumenogaster*

27. Abdomen more or less constricted at second segment 28

Abdomen not constricted, or slightly constricted at third segment (*Marcecidia*) 30

28. Abdomen strongly constricted, wasp-like; the anal area of hind wing reduced to a hairy lobe 29

Abdomen moderately constricted; anal lobe normal ..... *Æthria*

29. Shaft of antenna thickened and roughly scaled above near middle; male abdomen frequently with a long terminal filament *Trichura*

Shaft of antenna smooth and slender ..... *Argyroeides*

30. Antenna with middle part of shaft fringed with long hair; wings hyaline ..... *Dinia*

Antenna with shaft smoothly scaled; wings normally fully scaled 31

31. Palpi upturned, with third joint also erect, continuing the general line of the palpus 32

Palpi upturned or oblique, but with the third joint porrect, frequently long 43

32. Hind wing with M_2 arising from close to angle of cell or stalked with M_3 33

Hind wing with M_2 well separated from M_3 38

33. Fore wing with Cu_1 concave above, separate from M_3 at origin and strongly convergent to Cu_2 at margin; hind wing with M_3 and Cu_1 stalked ..... *Mydromera*

Fore wing with Cu_1 and Cu_2 normally divergent to margin ... 34

34. Both wings with M_2 and M_3 distinctly stalked; wings translucent *Atyphopsis*

Fore wing with M_2 and M_3 separate, hind wing with them separate or shortly stalked; wings normally opaque 35

35. Fore wing with R_2 stalked on R_{3-5} 36

Fore wing with R_2 free ..... *Hyaleucerea*

36. Basal segments of abdomen dorsally or subdorsally clothed with rough hair ..... *Eucerceon*

Abdomen smoothly scaled to base 37

37. Hind wing of normal size; tympanic hoods conspicuous above *Napata*

Hind wing relatively small, more or less aborted in male; tympanic hoods inconspicuous ..... *Androcharta*

38. Hind wing with M_3 and Cu_1 stalked 39

Hind wing with M_3 and Cu_1 arising separately from cell 40

39. Fore wing with R_2 separate; M_1 connate with R_{3-5} ..... *Aclytia*

Fore wing with R_2 stalked on R_{3-5}; M_1 arising distinctly separated *Heliura*

40. Abdomen dorsally or subdorsally clothed with rough hair toward base 41

Abdomen smoothly scaled to base ..... *Hypocladia*

41. Fore wing with M_2 and M_3 approximated for some distance from origin ..... *Ptergopterus*

Fore wing with M_2 and M_3 divergent from origin 42

42. Hind wing with M_3 and Cu_1 widely separated, with the transparent area sharply bounded; typically with R and M_1 stalked, and with R_2 free in fore wing, but the present species with R and M_1 of hind wing and R_2 of fore wing stalked ..... *Ecdemus*

Hind wing with M_3 and Cu_1 connate, the transparent area vague and partly scaled over; R_2 always stalked; R and M_1 of hind wing connate or barely stalked ..... *Episcepsis*

43. Shaft of antenna widened beyond middle; hind wing small, less than half as long as fore wing, the anal area reduced with a single anal vein; hind tibia of male much enlarged, with sex-scaling *Marcidia*

Antenna shaft normal; hind wing relatively larger, frequently large with ample anal area; hind tibia normal 44

44. Middle and hind tibiæ smooth ..... *Ctenucha*

Middle and hind tibiæ tufted at the spurs 45

45. Palpus with third segment set at an angle to second, which is oblique, and half as long; tip of second segment tufted; fore wing with M_2 and M_3 long-stalked, the wing very narrow *Correbia*

Palpus with third segment continuing the line of the second or with a gentle down-curve; wings moderately broad, M_2 and M_3 separate or only short-stalked, M_3 and Cu_1 often stalked *Correbidia*

Subfamily EUCHROMIINAE

Pompiliodes Hampson

A curious feature of this family is the close parallelism of pattern in members of the two subfamilies. Thus the perfect type of wasp-mimicry is duplicated in Pseudosphex and Argyroeides, though the narrowing at the "waist" takes place in a different way; the present genus (which is a mimic of Parachartergus) is duplicated by Amycles; Macrocneme by Horama; the aberrant Chrostosomas by Metastatia and Cacostatia, Dycladia by Correbia and Correbidia and so on. In this genus the wasp-waist is evanescent, but the general appearance is perfectly wasp-like.

322[1] Pompiliodes aliena Walker

Euchromia (*Pampa*) *aliena* Wlk. List Lep. Ins. B.M. i, 241, 1854.
Figured: Hamps. fig. 76[2]; Herrich-Schæffer, Aussereur. Schm. 73 (as *Glaucopis flavofascia*) 80 (as *Amycles* (*?*) *f.*), fig. 231; Seitz 10: k3.

Blackish, with a pale patch near apex of fore wing, large in male, more or less obsolete in female. *P. postica* Wlk. is merely the more southern race, with normally smaller pale patch. *P. tenebrosa* Wlk. differs in the mainly transparent hind wing.

Chief flight at end of Jan. (see diagram). Guatemala to Amazons.

Homœocera Felder

This genus begins the *Cosmosoma* complex, which extends to Saurita, probably the ancestor of the group. The genera are close and partly artificial, and the hairy vestiture is probably secondary, Sarosa, e.g. having two groups, one derived from Cosmosoma, the other from near Gymnelia. Homœocera has a lobed anal angle like Gymnelia, from which it also derives. The venational characters vary some and the key may not allow enough for individual variation, though it has been checked.

333 Homœocera stictosoma Druce

H. stictosoma Dr. Ann. Mag. Nat. Hist. (7) i, 402, 1898.
Figured: Hamps, 6: 17; Seitz 11: 4.

Easily recognized by the abdominal spots; subdorsal on 1, lateral on 2, both dorsal and lateral on 3.

[1] The numbers attached to the species refer to the appropriate volumes of Hampson's Catalogue of the Lepidoptera Phalænæ; the simple numbers are those cited as species in vols. i–iii, those with a decimal to forms cited there as subspecies, and those with a letter to the corresponding volumes of the Supplement (i, ii).

[2] Figures so cited are in black and white, showing pattern and venation.

Dominant at end of Jan. (see diagram. p. 101). Described from "Colombia" (at a date when Panama was part of Colombia).

Dyar reports *Isanthrene crabroniformis* Staud. (Biol. 6: 23; Seitz 9. 14), from the Canal Zone. It is yellow-hyaline, with black, yellow and blue abdomen.

Autochloris Hübner (*Bombyliodes* Hampson)

Differs from Gymnelia only in the more broadened antennæ. I follow Hampson in changing this name (Suppl. p. 102). It is a question of the identity of *Autochloris almon* (Cr.). The larva of *A. almon* as figured by Stoll (11: 1) is mouse gray, with 4 long anterior and two posterior black pencils, tipped with white.

363 Autochloris jansonis Butler

Gymnelia jansonis Btl. Cist. Ent. i, 116, 1872.
Figured: Butler, Lep. Exot. 61: 17; Seitz 11: b2.

Abdomen with a cream white bar across first segment, and orange streaks on middle segments. Three females.

May 25 (Friedman), July 12, 1924 (Banks); Nov. 9–10, (Am. Mus. Nat. Hist.). Costa Rica and Panama.

Sarosa Walker

This is a heterogeneous genus, *S. innotata* being a hairy variant of Cosmosoma (with the typical forms even more hairy) while *lutibasis* is merely a somewhat more hairy Autochloris. The female is less hairy than the male, female *lutibasis* being only about as hairy as males of Autochloris.

1. Disc of thorax and most of body yellow . . . . . *innotata*
   Body black with a double yellow patch at junction of thorax and abdomen . . . . . *lutibasis*

(380.1) Sarosa innotata Draudt

Sarosa notata, ab. 1 Hamps. Cat. Lep. Phal. i, 187, 1898.
Sarosa notata, form *innotata* Ddt. in Seitz Macrolep. World vi, 53, 11: f5, 1915.
? *Pœcilosoma semirubra* Ddt. in Seitz Macrolep. World vi, 202, 28: d9, 1917 (as determined in U. S. Nat. Mus.).

Wing form as in Cosmosoma; black head, shoulders, and tail with blue spots. The present specimens have less black than normal on the discal bar, and are undersized. The amount of black on the tegulæ varies.

Dec. 26, Jan. 3, 9, 10. Described from Ecuador.

378d Sarosa lutibasis Hampson

S. lutibasis Hmps. Ann. Mag. Nat. Hist. (7) viii, 171, 1901.
S. mora Dyar, Proc. U. S. Nat. Mus. xlvii, 161, 1914 (not Schaus).
Figured: Hamps. Suppl. 5: 20; Seitz 27: d7.

Body mostly black and blue, with a whitish lateral spot on third segment, but no orange or white stripes otherwise. No white spot at base of fore wing; wings deeply yellow.

Jan. 12–Apr. 3. Described from Panama. Ranges south to the Amazons (U. S. Nat. Mus.).

S. mora Schs. from Costa Rica, has a narrower border, more orange on costa, and a longer black streak in cell R_5.

Gymnelia Walker

Very close to the preceding genera, the antenna less swollen though perceptibly so in female. Third segment of palpus normally longer and almost porrect. This genus intergrades with Cosmosoma and many of the species were placed there in Hampson's 1898 revision. The lobed anal angle of the hind wing, now used by Hampson, intergrades perfectly, but the intermediate species so far known from the Canal Zone are small ones with yellow bodies (see Cosmosoma). There are now listed some 40 species, many of which will probably turn out to be merely color forms.

1. Abdomen striped with orange; much orange on body and wings; ventral valve of male half white. . . . . *beata*

   Abdomen black and blue except the orange tail; second segment of abdomen below usually merely edged with white. 2

2. Inner margin of fore wing with an orange patch, bisected by the black anal vein; first segment of abdomen dorsally practically wholly yellow. . . . . *perniciosa*

   Inner margin of fore wing mostly black; first segment of abdomen above with paired yellow spots or wholly black. 3

3. Larger; fore wing with black on discal bar practically limited to the angulate discal vein; front and extreme base of fore wing black with blue spots, only; end of abdomen orange; ventral valve of male white; inner margin of hind wing transparent. *salvini*

   Similar, but with discal bar slightly widened, and with no orange at end of abdomen; ventral valve of male practically wholly

black; inner area of h.w. solid black; under side of costa yellow, half as wide as cell, and cell itself with more yellow.
hyaloxantha

Smaller species, the front and base of f.w. with white spots; abdomen normally with 3 terminal segments orange; discal bar thick and straight..... *colona*

496, 390c Gymnelia beata Butler

Homœocera beata Btl. Jour. Linn. Soc. Zool. xii, 376, 1876.
Figured: Hamps. 8: 15; Seitz 13: h1.

Border extremely narrow; more orange on thorax as well as abdomen; more white on abdomen below.

Near light house, Dec. 1 (Schwarz, Am. Mus. N. H.) May 16 (Frost, U. S. Nat. Mus.) also Balboa, etc., and Colombia (type).

494, 391a Gymnelia salvini Butler

Homœocera salvini Btl. Jour. Linn. Soc. Zool. xii, 376, 1876.
Figured: Butler, Ill. Typ. Lep. Br. Mus. i. 7; 4; Seitz 14: m6 (as *Cosmosoma*).

Mid trochanters dark, contrasting with hind ones; no white on sides of thorax or base of wings; two anal segments orange, above and below; membrane of wings more orange than *colona*, less than *Sarosa lutibasis*. The abdominal segments have yellow basal lines, usually withdrawn within the preceding segments.

Common, all the year (see diagram, p. 101). Described from Panama.

391d Gymnelia hyaloxantha Dognin

G. hyaloxantha Dgn. Hét. Nouv. Am. Sud. vii, 4, 1914.
Figured: Hamps. Suppl. 6: 3; Seitz 27: d5.

Very near the preceding, and perhaps a variety of it, but with no orange on abdomen. The female type has the border of the wings broader than the present specimen which agrees with *salvini*. Valve black; costa of hind wing below orange.

July-Aug. (Fairchild), one male determined by Schaus as *salvini*. Described from Colombia on one female.

391b Gymnelia colona Schaus

Cosmosoma colona Schaus, Ann. Mag. Nat. Hist. (8) vii, 177, 1911.
Gymnelia cennocha Schs. Proc. U. S. Nat. Mus lxv (7) 4, 1924.
Figured: Hamps. Suppl. 6: 1; Seitz 27: c10.

A strikingly variable species. In typical *colona*, which is the dominant form, the anal orange covers part of the 6th segment above, and occasionally below, but there is no orange of the costa of the fore wing or yellow on first segment of abdomen. In *cennocha* Schs. the anal orange is reduced; specimens were also taken with yellow spots on first segment of abdomen or an orange costal stripe on fore wing, or with the sixth segment below mostly orange. Part of Dyar's *mathani* from the Canal Zone was based on yellow-spotted specimens of this.

Dominant in February and common (see diagram, p. 101). Described from Costa Rica.

The U. S. National Museum has a single specimen of *G. mathani* Roth. (Hamps. Suppl. 8: 6) from Paraiso, C. Z. The border is twice as broad, the first abdominal segment is paler yellow, except a median black dot, and the 7th segment is conspicuously black and blue on the sides.

Gymnelia perniciosa Dognin

G. perniciosa Dgn. Hét. Nouv. xxiii, 1, 1925.

Similar to *colona*, except as noted in key; the yellow on first segment of abdomen is deeper than in *G. mathani*.

Feb. 10, 1 ♀ (A.M.N.H.); Apr. 7 (Fried.), 1 ♂. Described from Colombia.

Phoenicoprocta Hampson (*Hyela* Walker n.b.l.)

The small subterminal tufts on the abdomen are sometimes turned under and inconspicuous, especially in the female. The following species is aberrant in having the abdomen constricted at the third segment and bulbous beyond, and lacking the separate anal lobe. It has close relatives (or possibly color forms) now standing as Cosmosoma (*gemmata* Btl., *subflamma* Wlk.)

1. Male abdomen with crimson subdorsal stripes and under side, female black and blue. . . . . *insperata*
   Abdomen black, with orange middorsal spot on fourth segment. *paucipuncta*

Phoenicoprocta paucipuncta Dyar

P. paucipuncta Dy. Proc. U. S. Nat. Mus. xlvii, 161, 1914.
? *Pheia gemmata* Btl. Jour. Linn. Soc. Zool. xii, 385, 1876.

Easily recognized by the orange middorsal spot, sometimes preceded and followed by smaller spots. This is probably merely a partial race

of *Cosmosoma gemmata* Btl. (Hamps. No. 504) from Venezuela. The body form and anal tufts may be unrecognizable in specimens that have been papered.

Nov.-Apr., common (see diagram, p. 101). Described from Canal Zone and only known from there, except for a single specimen in the U. S. National Museum from Venezuela, mixed with true *gemmata*.

P. insperata Wlk. (*rubiventer* Roth.) (Seitz 12: c1) is reported by Dyar from the Canal Zone.

Pheia Walker

Differs from Cosmosoma only by the extremely short dorsal side of the cell, with the lower limb of the discocellular almost lost (not quite as Hampson states). *P. elegans* is very close to *Cosmosoma saron*, even having the same arrangement of blue spots on the body. The typical species of Pheia have nearly simple antennæ.

1. Abdomen with small waist and tympanic hoods flattened against thorax as in Pseudosphex ..... *stratiotes*
   Abdomen not constricted, hoods inflated 2
2. Abdomen mainly orange, male antennæ well pectinated ... *elegans*
   Abdomen mainly black; male antennæ serrate 3
3. Paired cream spots on first segment of abdomen ..... *utica*
   A single bar on first segment ..... *albisigna*

419 Pheia elegans Druce

Cosmosoma elegans Dr. Biol. Centr. Am. Het. i, 59, 7: 13, 1884.
Also *figured:* Seitz 12: d5.

Easily recognized by the abdomen, in which segments 2 and 6–8 are black, with subdorsal as well as dorsal blue spots, but 3–5 are mostly orange.

Jan. 23 (Bts.) Feb. 8 (Fried.); also taken by Bates at Lancetilla, Honduras. Mexico to Venezuela and Bolivia (U.S.N.M.).

425 Pheia albisigna Walker

Glaucopis (Pheia) albisigna Wlk. List Lep. Ins. Br. Mus. i, 146, 1854.
Pheia proteria Schs. Proc. U. S. Nat. Mus. lxv (7) 5, 1924.
Figured: Butler Ill. Lep. Het. Br. Mus. i, 7: 14; Seitz 12: f1.

A scarlet spot at base of fore wing and scarlet spots on collar and shoulders. Mid tibiæ much enlarged in male.

Mar. 25 (Fried.) Honduras to Amazons.
Dyar reports *P. utica* Druce and *P. stratiotes* Dyar.

Loxophlebia Butler

The wide space between the origins of M_2 and M_3 in the fore wing separates this from most other Euchromiidæ. Mesothen is very close, but the cell of hind wing is slightly longer.

Larva of *L. diaphana* with sparse tufts of hair, pencils on prothorax and segments 1 and 8 of abdomen; the pencils are slender on prothorax, short and dense on abdomen (Sepp, Ins. Surinam ii, 185, pl. 81; Hamps. i, 209). It feeds on Sapindaceæ.

1. Abdomen with black middorsal stripe above much broken or absent; under side also largely yellow..... *flavipicta*
   Abdomen with a continuous middorsal black stripe on thorax and abdomen; under side black, with white valve..... *leucothema*.

427f Loxophlebia flavipicta Schaus

L. flavipicta Schs. Ann. Mag. Nat. Hist. (8) ix, 34, 1912.
Figured: Hamps. Suppl. 6: 28; Seitz 27: f6.

Male ventral valve enormous, extending to opposite end of 4th dorsal segment. Yellow, head and tail black; typically with a rounded mid-abdominal spot, usually without; the only female at hand with a broken longitudinal stripe on thorax and abdomen. Fore wing with an orange band crossing both transparent and opaque parts.

Oct., Dec., to Mar., May. Costa Rica.

Loxophlebia leucothema Dyar

L. leucothema Dy. Proc. U. S. Nat. Mus. xlvii, 160, 1914.

Black. Collar orange; orange longitudinal subdorsal stripes from mesothorax almost to apex of abdomen. Wing-veins all black. Under side black, the valve large and broad and solid white. Female with white subventral stripes, connected across posterior edge of second (first chitinized) segment.

May 30 (Fried.) ♂; Lancetilla, Honduras, May 3 (Bates) ♀. Described from the Canal Zone and Venezuela.

Mesothen Hampson

1. Thorax yellow..... *pyrrha*
   Thorax black, with white shoulder-spots..... *ethela*

445 Mesothen pyrrha Schaus

Dycladia pyrrha Schs. Ent. Am. v, 89, 1889.
Figured: Biol. 71: 27; Seitz 12: i5; Hamps. fig. 101.

A recognition character is the double white bar on metascutellum and base of abdomen. Wings hyaline, with black veins and broad borders.

All season (see diagram, p. 101); also taken by Bates at Lancetilla, Honduras. Mexico to Guiana.

443c Mesothen ethela Schaus

M. ethela Schs. Ann. Mag. Nat. Hist. (8) vii, 175, 1911.
Figured: Hamps. Suppl. 7: 14; Seitz 12: i4.

Separable from *Cosmosoma melanotela* and *stibostictum* by the venation and white shoulder-spots.

Nov. 26-Apr. 5 (see diagram). Hamburg Farm, C. R. (Dodge). Described from Costa Rica.

Note that *Mesothen albifrons* of Seitz is *Cosmosoma galatea* Schaus, q.v.

Chrostosoma Hübner

A variant of the Cosmosoma type with R_1 invariably stalked on the R-stem. All the local species have scarlet spots on shoulders and base of abdomen. Hampson's grouping by the presence or absence of Cu_1 is incorrect, as all the species have preserved it. It is longer in the second group, which has not yet been found in the Canal Zone.

1. Discocellular spot of fore wing much thickened; under side of body black. . . . . *echemus*
   Discocellulars of fore wing black along the veins only; under side of body white in male. 2
2. Blue metallic scaling on base of front, back of head, a bar on scutellum, collar and subdorsally on abdomen. . . . . *n. sp.*
   No blue metallic markings, the body with very faint general iridescence in a strong light. . . . . *tabascensis*

452 Chrostosoma echemus Stoll

? *Sphinx Adscita echemus* Stoll, in Cramer Pap. Exot. iv, 147, 367: B, 1781.
? *Læmocharis stulta* H.-S. Aussereur. Schm. i, 80, fig. 258, 1854.
? *Glaucopis (Pheia) dolens* Walker, List Lep. Ins. B. M. i, 148, 1854.
Also *figured:* Seitz 12: k6.

This is a true Chrostosoma, though it stands in the U. S. National Museum as *Saurita stryma*. Cramer's figure is very bad, showing a red head; *dolens* Walker has blue lateral spots and under side of abdomen white, while *stulta* is based on a figure alone, which does not show these points, but does show an orange collar and a differently shaped black border. So the name remains uncertain.

Dominant at beginning of Dec. (see diagram, p. 101). *Echemus* was described from Surinam, *dolens* from Para, *stulta* without locality.

Chrostosoma tabascensis Dyar

C. tabascensis Dy. Proc. U. S. Nat. Mus. li, 5, 1917.

The *decisa* group of Chrostosoma is a desperate one, that can probably be solved only by much material and genitalic studies. The Panama species differ from true *decisa* and *hæmatica* in having the white on the under side of the male hind wing limited to a subbasal patch on the costa and the costal half of the cell. In typical *tabascensis* there are no blue spots, but in half the present series there are blue spots on various parts of the body. It is not clear whether these are a good species. *C. destricta* Ddt. must be similar, but is described as having the red spot on the metathorax and a white one on first segment of abdomen (like *Saurita phœnicosticta*); *Psilopleura albipes* Ddt. (Seitz 15: c4) must also be similar, but the present lot are true Chrostosomas.

Normal form late Oct. and Dec.; blue spotted specimens also in Jan. and July-Aug. *C. tabascensis* is in the National Museum from Mexico and Guatemala.

Cosmosoma Hübner

This name was first used by Hübner in the Sammlung Exot. Schm. ii, pl. 369 (Kirby's numbering), was abandoned in the Verzeichniss, but taken up by Harris in 1839 (Silliman's Journal xxxvi, 317). Hampson originally included many species with lobed hind wing that he has since removed to Gymnelia, but the genus still includes various lobed species, and needs further revision. It is central for this group, and leads into most of the preceding genera.

The larva of *C. myrodora* has the usual dense tufts on sides of 1st and 8th segments of abdomen, and sparse prothoracic pencils; it feeds on *Mikania*.

1. Discal bar large, centered with scarlet . . . . . *teuthras*
   Discal bar black and almost always narrow, concolorous with other veins 2

2. Abdomen largely yellow, orange or red, at least laterally on first four segments 3
   Abdomen black and blue, at most with orange lateral patches on two basal segments or a middorsal stripe 10
3. An irregular middorsal black and blue band; sides of thorax and first four segments of abdomen scarlet . . . . . *auge*
   Thorax without dark middorsal band, abdomen with a faint fine one or none; blue middorsally on tail only or none 4
4. Thorax orange, concolorous with most of abdomen . . . . . *batesi*
   Thorax yellow on disc, the tegulæ or their outer edges contrasting, black; collar black 5
   Thorax solid black, contrasting with the orange or yellow abdomen 6
5. Large, all veins black, tegulæ all black, or with a longitudinal stripe . . . . . *Sarosa innotata*
   Small; veins antemedially yellow; bases of tegulæ yellow. *semifulva*
6. End of abdomen black, sometimes spotted with blue 7
   End of abdomen yellow, concolorous . . . . . *hercyna hercynacula*
7. Head and thorax much shaded with bright blue, abdomen orange. *zurcheri*
   Head and thorax dull black, abdomen yellow 8
8. Abdomen with five segments yellow, above and below; white spots if present located on wing-bases 9
   Abdomen with only 4 yellow segments above, six below; white spots on bases of tegulæ; valve long . . . . . *galatea*
9. Small species, discal bar much thickened; border much widened below Cu_2 in both wings; thorax solid black. *h.h.* var. *melanotela*
   Larger species; discal bar limited to the angled vein; border nearly even; thorax with several white dots . . . . . *stibostictum*
10. Discal bar very thick; sides of thorax and base of abdomen orange. *cæcum*
    Discal bar moderate; no orange subdorsally 11
11. Tegulæ with orange stripes; male with a large blackish or orange patch opposite lower angle of cell . . . . . *remotum*
    Tegulæ with a blue stripe; male without scaled patch between cell and anal angle 12
12. Face white; fore wing with the transparent area between Cu and fold extending to base of wing 13

Face blue; fore wing with base solidly black out to ¼ length of cell and bearing a blue spot; subdorsal spots on abdominal segments 2 and 3 enlarged and coppery. . . . . *xanthostictum*

13. Fore wing black and pure transparent (except the blue basal spot); abdomen with a regular series of subdorsal blue patches. *metallescens*

Fore wing with both membrane and scaled portions scaled or tinted with orange; subdorsal patches on second segment of abdomen much enlarged. . . . . *saron*

GROUP IA. *Stalk of* M_3 *and* Cu_1 *almost as long as lower side of cell preceding it, or free part of* Cu; *abdomen of male with well developed ventral valve* (Cosmosoma).

477 COSMOSOMA AUGE Linnæus

Sphinx auge Linn. Syst. Nat. (Ed. 12) i (2) 807, 1767.
Cosmosoma omphale Hübner, Samml. Exot. Schm. ii (369), 1823.[1]
Also *figured:* Holland, Moth Book 13: 1; Seitz 13: c1.
Larva and *pupa:* (of *C. a. myrodora* Dyar) Dyar, Psyche, vii, 414, 1896; Hamps. 228.

Easily recognized by the scarlet legs and lateral stripes. Larva with black and white hair, on Mikania.

Feb. 24 (Fried.). Lancetilla, Honduras, (Bates). Mexico and Antilles to Uruguay, a race in Florida.

480 COSMOSOMA ZURCHERI Druce

C. zurcheri Dr. Ann. Mag. Nat. Hist. (6) xii, 353, 1894.
Figured: Hamps. 8: 19; Seitz 13: d1.

The blue head and prothorax, and decidedly orange hind-thorax and abdomen are distinctive.

Oct. 28 and Jan. 30 (Bts.) Costa Rica.

480c COSMOSOMA GALATEA Schaus

Cosmosoma galatea Schs. Ann. Mag. Nat. Hist. (8) ix, 35, 1912.
Mesothen albifrons Ddt. in Seitz Macrolep. World 27: h5 (not Schaus).
Also *figured:* Hamps. Suppl. 8: 8.

This species is very close to *M. albifrons*, having the narrow valve of Mesothen, and a very short cell to the hind wing, but in the unique

[1] Date shown by Hemming, 1937. This is plate 156 of his numbering.

type of *M. albifrons*, M_2 of the fore wing is straight and well separated from M_3. The white shoulder spots are as in *M. ethela*, but there are additional paired dots on collar and vertex.

Dec. 24 (Bates), 1 ♂. Described from Costa Rica.

Cosmosoma semifulva Dr. (Biol. 8: 11) is reported by Dyar from the Canal Zone. It resembles a small *Chrysostola mellita*.

GROUP IB. *Venation as before; no ventral valve.*

COSMOSOMA SARON Druce

C. saron Dr. Biol. Centr. Am. Het. i, 59, 7: 14, 1884.
C. meres Dr. Ann. Mag. Nat. Hist. (6) xviii, 30, 1896.
Also *figured:* Biol. 71: 23 (as *meres*); Seitz 13: k7.

In typical *saron* (also in the type of *meres*) there are two pairs of orange spots on the abdomen, which are missing on all the Panama specimens, and most of the others seen. The pattern is remarkably like that of *Pheia elegans*, but the cell of the hind wing is a little longer.

Jan. to June (see diagram, p. 101). Described from Chiriqui.

509 COSMOSOMA METALLESCENS Ménétries

Læmocharis metallescens Mén. Cat. Lep. Petr. ii, 138, 14: 1, 1857.
Also *figured:* Seitz 13: k4.

The wing-form leans to Gymnelia. It is recognizable by the white spots on front and patches on hoods, and triple series of spots on abdomen.

Chief flight in Jan. (see diagram). Lancetilla, Honduras, (Bates). Mexico to Amazons.

510 COSMOSOMA BATESI Butler

Dycladia batesi Btl. Jour. Linn. Soc. Zool. xii, 394, 1876.
Figured: Hamps. 9: 7; Seitz 13: k5.

Yellow parts decidedly orange; face white.

Feb. 1, Mar. 3, Apr. 26. Ranges to Para and S. Brazil.

515 COSMOSOMA XANTHOSTICTUM Hampson

C. xanthostictum Hamps. Cat. Lep. Phal. i, 240, 9: 21, 1898.
C. metallescens Dr. (in error) Biol. i, 58, 1884.
Also *figured:* Seitz 13: 14.

The strongly coppery subdorsal spots on second and third segments

of abdomen are distinctive; the female has a large mass of yellow hair on the under side of the abdomen, which is presumably mixed with the eggs when laid.

Males Oct. to Jan., female Apr. Also taken by Bates at Lancetilla, Honduras. Ranges north to Mexico.

GROUP IIA. *Hind wing with lower side of cell longer, the stem of* M_3+Cu_1 *being about half as long as cell, and as length of free part of* Cu *with its branches. Scaling of border of hind wing below rough and slightly raised. No valve.*

531 COSMOSOMA REMOTUM Walker

Glaucopis (*Cosmosoma*) *remota* Wlk. List Lep. Ins. Br. Mus. i, 170, 1854.
? *C. bolivarensis* Klages, Proc. U. S. Nat. Mus. xxix, 356, 1906.
Figured: Hamps. 9: 22; Seitz 14: c6 (♂ only).

In this little group the males have a fully scaled patch opposite the lower angle of the cell. The half dozen nominal species may probably be reduced to one or two; they differ mainly in the amount of orange on body and fore wings; which reaches a maximum in the Pto. Rican *C. achemon tyrrhene* and is absent in *C. centrale* from Brazil. The present form has a blue collar, with a few orange scales at most, *C. festivum* Wlk. is almost identical but with orange collar.

Oct. 26; Jan. to Mar. Ranges south to Venezuela.

GROUP IIB. *Cell large as in IIA; under side of hind wing smooth; valve absent.*

523 COSMOSOMA TEUTHRAS Walker

Glaucopis (*Cosmosoma*) *teuthras* Wlk. List Lep. Ins. Br. Mus. i, 168, 1854.
Figured: Butler Ill. Lep. Het. Br. Mus. i, 13: 5; Hamps. fig. 110; Seitz 14: b2 (typical), 3 (*cingulatum*), 4 (*lignicolor*), 5 (*restrictum*).

The races differ in the amount and shade of the red or orange. Hampson assigns the Panama specimens to the typical (Venezuelan) form, but *C. t. cingulatum*, ranging from Mexico to Veragua (west Panama) is almost the same. Seitz's fig. b2 shows far too much orange on the inner margin.

Dec. to Apr. 5; July. La Venta Farm, Panama (Bts.). The species ranges from Mexico to S. Brazil.

525 COSMOSOMA CÆCUM Hampson

C. cæcum Hamps. Cat. Lep. Phal. i, 246, 1898.
Figured: Biol. 71: 22 (as *impar* Wlk. in error); Seitz 14: c1.

Border more irregular than in *C. teuthras*, and discal spot large but wholly black (figured by Seitz as with a small red center). Thorax with black and blue middle spots.

Nov., Jan., Mar. also Chiriqui (A.M.N.H.), Lancetilla, Honduras (Bts.). Ranges north to Mexico.

545 Cosmosoma hercyna hercynacula Dyar

C. hercynacula Dy. Proc. U. S. Nat. Mus. xlvii, 161, 1914.
C. h. var. *melanotela* Dy. Proc. U. S. Nat. Mus. xlvii, 161, 1914.

Thorax black, the metathorax typically yellow, but black at sides in *h. hercynacula*, leaving the scutellum yellow; abdomen typically wholly yellow, the last two segments black in var. *melanotela;* border of fore wing extending 2/5 way in to end of cell (typically narrower).

Dates scattering (see diagram, p. 101). Eleven specimens of v. *melanotela* with 20 of the type. Typical *hercyna* is known from Mexico, Nicaragua, and Lancetilla, Honduras (Bts.); *hercynacula* and *melanotela* were described from the Canal Zone.

547 Cosmosoma stibostictum Butler

Ilipa stibosticta Btl. Jour. Linn. Soc. Zool. xii, 391, 1876.
Figured: Hamps. 9: 11; Seitz 14: g5.

The base of the fore wing has a small white spot, and a white speck beyond it.

Nov., Mar. 16, May, June, July-Aug. Honduras (Bts.). Hampson also reports it south to Colombia.

Rhynchopyga Felder

Similar to *Saurita*, except that M_3 and Cu of the hind wing are markedly stalked, and the fore wing is much narrower, nearly 3 times as long as wide. In the typical species the anal segment is long and beak-like (whence the name) but the rest of the genus are normal.

I transfer *Saurita cryptoleuca* here with some doubt. It is no Saurita, and would run here in a key, but I do not know the male.

1. Neck and collar orange, disc of hind wing transparent.. *flavicollis*
   Collar with red scales, shoulders and hoods with red dots; disc of hind wing blue..... *cryptoleuca*

596 Rhynchopyga cryptoleuca Walker

Euchromia (*Pampa*) *cryptoleuca* Wlk. List Lep. Ins. Br. Mus. i, 239, 1854.
Figured: Hamps. 10: 21; Seitz 15: f1.

The contrasting blue hind wing with a small transparent anal patch is unique in the Euchromiidæ. The male may be more largely transparent, but will probably show the same red markings.

July-Aug. (Fairchild) (Banks). Guiana and Amazons.

Dyar reports *R. flavicollis* Druce (Biol. 7: 11). The base of fore wing and most of hind wing are transparent, and there is no red or blue.

Saurita Herrich-Schäffer (with *Hypocharis* Hampson)

A varied genus, both in structure and coloring, perhaps ancestral to most of the preceding. M_3 is barely stalked or connate with Cu, and the membrane is frequently fully scaled (like Rhynchopyga, but unlike most of the preceding). Barro Colorado Id. is relatively rich in species.

1. Thorax solid orange, contrasting with the black scaling of the wings....2
   Thorax mostly black....5
2. First segment of abdomen black; orange parts more yellow; wings broader with normal anal area....*afflicta*
   First segment of abdomen at least subdorsally, and base of wings orange, the tint redder; wings narrow with anal region of hind wing reduced....3
3. Abdomen spotted with blue, the first segment black middorsally, with a blue spot....*anselma*
   Abdomen not spotted with blue; first segment solid orange above. 4
4. Head black on vertex and white behind eyes....*sanguinea*
   Vertex and head behind eyes both orange, only the anterior head black and white; wings more opaque....*incerta*
5. Body with red spots....6
   Body without red spots....9
6. Red spots on shoulders, and a middorsal one on first segment of abdomen; hind wing short....7
   Red spots on shoulders, vertex and scutellum....*phœnicosticta*
   Red spots on shoulders and top of tegulæ only, no unpaired spots; hind wing long and fully scaled....*tetræma*
   Sides of thorax red in front; wings with transparent patches....*mora*
7. Wings transparent with large discal spot; no red spots on dorsum of tegulæ....*Chrostosoma echemus*
   Wings slightly translucent; the hind wing with fine even modified scaling, except along costa; tegulæ with red dorsal patches....8

8. Smaller; body marked with blue.....*clusia*
   Larger, no blue.....*nox*
9. Fore wing black, hind wing blue.....*Rhynchopyga cryptoleuca*
   Wings translucent between veins, all black.....*tipulina*

GROUP I. *Hind wing rather narrow, with normal anal area; hind tibia with upper spurs rudimentary; male (unknown in present species) with ventral valve* (Saurita).

SAURITA TETRÆMA new species

Similar to *Saurita cassandra*. Smaller, darker, dull dark brown, wholly without blue markings; the dark veins and shadings not contrasting, but with perceptible darker shades over end of cell and near apex of fore wing and near apex and anal angle of hind wing. Palpi wholly black. The only contrasting markings are two crimson spots on each tegula, on shoulder and along upper edge.

The 7 specimens are all females, but in this group the sexes are similar. The species will key in Hampson to *S. mora* Druce, but looks entirely different. 25mm.

Barro Colorado Id., Panama, holotype Nov. 23, 1924, (Bates); paratypes from the same place, Nov. 19-Jan. 29 (Bates).

GROUP II. *Hind wing nearly as broad as long, ample, the scaling fine, even and spaced, except along costa and upper half of cell where it is normal; hind tibiæ normal; no valve* (Hypocharis).

593 SAURITA CLUSIA Druce

Læmocharis clusia Dr. Ann. Mag. Nat. Hist. (6) xx, 303, 1897.
Figured: Hamps. fig. 125; Seitz 15: e5.

Hampson proposed the genus Hypocharis for this species alone, but the venational difference given is imaginary, all the species having M_1 more or less separate from upper angle of cell. *Clusia* is smaller than *nox*, the white postmedial band is narrower sex for sex, and the blue spotting is distinctive.

Dominant in Dec. (see diagram, p. 101). Described from the Amazons.

606 SAURITA NOX Druce

Læmocharis nox Dr. Ann. Mag. Nat. Hist. (6) xviii, 30, 1896.
Figured: Biol. 71: 11; Seitz 15: g7 (unrecognizable, perhaps based on a specimen of *S. fumosa*).

There are no blue spots; in the male the white area invades the outer

third or half of the cell, in the female the extreme apex of the cell may be pale.

Two heavy flights, Oct. and late Dec. (see diagram, p. 101), commoner than *S. clusia*. Lancetilla, Honduras (Bts.), Venezuela.

GROUP III. *Hind wing normal, narrow, with the anal region a little reduced in width, but basal part of inner margin strongly convex; spurs normal, no valve* (Echoneura).

604 SAURITA MORA Druce

Dycladia mora Dr. Biol. Centr. Am. Het. ii, 348, 72: 8, 1897.
Also *figured:* Seitz 15: g4.

The present specimen like the type is a female. Inner margin of hind wing somewhat reduced; upper spurs rather short. Black; body marked with blue and white, fore wing with two, hind wing with one transparent patch, both divided by black veins.

Dec. 29, 1928 (Curran — Am. Mus. Nat. Hist.). Chiriqui (type).

607 SAURITA PHŒNICOSTICTA Hampson

Læmocharis trigutta Dr. Biol. Centr. Am. Het. i, 55 (not Walker).
S. phœnicosticta Hamps. Cat. Lep. Phal. i, 277, 10: 17, 1898.
Also *figured:* Seitz 15: g6 (unrecognizable).

Differs from all our species of Saurita by the half-scaled wings, with thickened discal bar. Seitz's figure indicates a much too transparent form.

Dominant in Dec.-Jan. (see diagram). Lancetilla, Honduras (Bts.), Guatemala (Type).

608 SAURITA INCERTA Walker

Tipulodes ? incerta Wlk. List Lep. Ins. Br. Mus. vii, 1627, 1856.
Figured: Felder Reise Novara Lep. 102: 23 (as *corallonota*); Seitz 15: h3.

Fore coxæ of male white; translucent areas diffuse, in and below cell. 22mm.

Feb. 8, June 13, July (Banks). Jan. to July; also Colombia.

610 SAURITA SANGUINEA Druce

Thrinacia sanguinea Dr. Biol. Centr. Am. Het. i, 56, 7: 9, 1884.
Also *figured:* Seitz 15: h5.

Head black and white without any red. Fore coxæ mostly black in

both sexes. Slightly larger (28 mm.); transparent area less diffuse, and usually more extensive, with a small separate spot in fork of Cu.

Nov. 24, Jan. 28 (Bts.), Mar. 12 (A.M.N.H.). Guatemala (types).

Saurita anselma Schaus

Saurita anselma Schs. Proc. U. S. Nat. Mus. lxv, (7) 8, 1925.

Larger and heavier, with the transparent areas larger and more sharply bounded, frequently with spots beyond cell.

Dominant flight in Jan. (see diagram, p. 101). Described from the Canal Zone.

615 Saurita afflicta Walker

Saurita temenus auct. not Stoll.
Glaucopis (*Pseudomya*) *afflicta* Wlk. List Lep. Ins. Br. Mus. i, 144, 1854.
Saurita venezuelensis Klages, Proc. U. S. Nat. Mus. xxix, 538, 1906.
Figured: Butler, Ill. Lep. Het. Br. Mus. i, 7: 12; Seitz 16: b1.

The whole head and under side is black, unlike true *temenus*. The yellow at the wing base is much reduced, and the whole moth is softer looking than the preceding; the male is solid black on outer half of wings, the female translucent almost to the margin.

True *S. temenus* of Stoll has the under side of the body yellow, and the wings more transparent, the male being about like female *afflicta*.

Dominant in Dec. (see diagram). Lancetilla, Honduras (Bts.) to Amazons, common.

622 Saurita tipulina Hübner

Glaucopis unicolor *tipulina* Hüb. Samml. Exot. Schm. i, 163 (Kirby's numbering), 1812.
Also *figured:* Butler Ill. Lep. Het. Br. Mus. i, 7: 7; Seitz 15: k2.

Wholly black, otherwise like *S. afflicta*, but the male wings more translucent, as in female *afflicta*.

Jan. 25, Feb. 5, Mar. 4, Apr. 5. Guatemala to Southern Brazil.

Psoloptera Butler

A variant of Saurita, differing only in R_2 being stalked with R_1 instead of R_{3-5}.

629 Psoloptera thoracica Walker

Euchromia (*Autochloris*) *thoracica* Wlk. List Lep. Ins. Br. Mus. i, 243, 1854.
Figured: Butl. Ill. Lep. Het. Br. Mus. i, 8: 6; Seitz 15. m4.

Black; with scarlet vertex and thorax, blue subdorsal points on first segment of abdomen and two on base of fore wing.

All the year round, the heaviest flight in April (see diagram, p. 101). Guatemala to Amazons.

Dycladia Felder

This genus and Histiæa represent the true Euchromia group. The wings are rather acute, and the patterns conspicuous.

1. Wings less transparent; apical patch of fore wing some three times diameter of discal spot; a black patch between discal spot and anal angle..... *correbioides*

   Wings more transparent; apical patch less than twice diameter of discal spot, which is connected with anal angle by only faint traces of dark shading..... *vitrina*

649 Dycladia correbioides Felder

D. correbioides Fld. Reise Novara Lep. 102: 20, 1874.
Also *figured:* Hamps. fig. 136; Seitz 16: d5.

The resemblance to Correbia and Correbidia is striking, in fact the specimens were received mixed with members of those two genera. Probably all three, and Lycomorphodes of the Lithosiinæ as well, are mimics of Lycidæ.

Jan., Feb., Mar., Apr., July-Aug. (see diagram). Mexico to Colombia.

Dyar described *D. mamha* (a synonym of *vitrina* Roth., Nov. Zoöl. xx, 13: 35) from the Canal Zone. It ranges from Honduras (Bates) to Ecuador (type).

Macrocneme Hübner

This genus is the Euchromiine member of a very distinctive group of black and green moths, frequently with enlarged hind legs, which presumably mimic certain Vespidæ. Others are Horama, Calonotos, Ceramidia, Antichloris and Amycles.

A few of the species of Macrocneme have R_2 more or less constantly free, and intergrade with the second group of Calonotos; in the latter M_2 and $_3$ are closely parallel for a distance beyond their origin. The leg characters used by Hampson for grouping are partly imaginary; the white spotting of the first segment of abdomen and male valve and genitalic type make a better separation. The genitalia must be viewed from various sides to be properly understood, so cannot be mounted on slides; it is usually possible to draw them out with a hook, so as to

display all the essential features (especially when fresh). They are so heavily chitinized that there is no substantial distortion. As the genitalia have not yet been studied on authentic specimens, and the superficial characters are weak or even nil, the following determinations are subject to correction.

Larva of *M. leucostigma* dark with sky blue warts (Jörgensen).

In the following key I have included several species not actually known from Panama, where it seemed worth while to note their characters. It will apply only to males, and should be used in connection with the genitalic figures. The green patterns are distinctive in some cases, but so variable that they cannot be clearly described.

1. Abdomen with a pair of white spots on first tergite, the blue spots on hoods less conspicuous; male without ventral valve on first segment; the genitalia with large bifid valves, nearly symmetrical, scoop-like juxta, and fairly simple uncus, the juxta and uncus somewhat unsymmetrical as a rule; female antennæ narrowly pectinate (*Macrocneme*) 2

   Abdomen without a pair of white spots on first tergites, though sometimes with blue-white spots on hoods; male with small ventral valve, usually white-edged; genitalia highly unsymmetrical so far as examined; valves simple, the right one much larger and farther ventrad than the left; tegumen frequently with a large process on right side and juxta massive; female antennæ simple, fusiform 8

2. Fore wing with iridescence covering most of surface, varying in color to blue and even purple, normally extending broadly and evenly at least half way from cell to apex; male hind tarsus normally with a single white segment, female wholly black. *cyanca, adonis, maja* Hbn. not F.

   Iridescence of fore wing usually evenly colored, green, rarely even brassy; usually not extending far beyond cell, or with a black ray extending in to cell 3

3. Juxta long, but abruptly narrowed from right side at half its length to half its width (fig. 7). Green of fore wing solid to middle, with faint traces only of a darker interruption in fold; very glossy; tip of hind tarsus white ..... *aurata* (*semiviridis*)

   Juxta gradually though unsymmetrically tapering to a pointed or truncate apex; green of fore wing interrupted antemedially at least by a heavy oblique black bar in fold, frequently divided into several spots 4

4. Juxta enormous, when everted extending beyond all other structures, at rest upturned behind the other structures and covering the uncus, pointed and twisted; under side of hind wing green only along costa; hind tibia all black. . . . . *cinyras*
   Juxta scooplike, truncate, shorter than valves. 5
5. Hind tarsus all black, under side of hind wing mostly green; green area of fore wing rather broad and even, not ragged or interrupted, usually with some brassy tint. . . . . *chrysitis* (*iole*)
   Hind tarsus with white tip; green area of fore wing not brassy, with ragged outer boundary or more or less interrupted with black. . 6
6. Under side of thorax and abdomen dominantly white, the white stripe extending broadly to its tip. . . . . *thyra* (*albiventer*)
   Under side of thorax with large white spots, of abdomen with broad white stripe toward base, narrowing and breaking into small spots toward apex, the terminal segments black. *thyra*, var.
   Under side of body with small white spots only, black. 7
7. Upper side of uncus broad; with one or two unsymmetrical keels on its dorsal surface, besides the lateral keels; valve simple (Brazil). . . . . *leucostigma*.
   Upper side of uncus less broad, with the two lateral keels only, the middle forming a flattened dome; valve simple, collar with two pairs of small white spots. . . . . *thyridia* (*euphrasia*, *guyanensis*)
   Upper side of uncus as before, the lateral keels much inflated; valves with a sharp tooth on upper inner edge (fig. 8) collar with the two white spots large and connected in front. . . . . *sp.*
8. Abdomen above with three rows of large green spots; larger species, genitalia apparently more massive. 9
   Abdomen above solid green, or with brighter lines on a deeper green or blackish ground; valves slender, the left one very small. 10
9. First segment of abdomen above red. . . . . *apollinairei*
   First segment of abdomen above bright yellow. . . . . *xantholopha*
   First segment of abdomen above black. . . . . *cyanescens*
10. Disc of hind wing translucent, at least in male; uncus slender and merely hooked, right process of tegumen also slender. 11
    Hind wing evenly scaled, like fore wing; uncus so far as examined sharply bent or T-shaped; right lobe of tegumen stout when present. 12
11. Markings of body underlain with yellow, appearing coppery to some extent. . . . . *laciades*
    Collar with large bright yellow spots. . . . . *misitra*

Without distinct yellow markings, marked with white.... *laconia*

12. Hind tarsus largely bright yellow.....13
Hind tarsus with terminal segments white.....15
Hind tarsus wholly black.....22

13. Fore wing almost all black, with a wedge-shaped green dash in base of fold; larger (40 mm.); valve edged with white..... *jalapensis*
Fore wing with a median green shade of variable size resting on costa; generally smaller (30 mm.).....14

14. Valve entirely black; a separate green streak along upper edge of anal vein from base nearly to outer margin..... *chrysotarsia*
Valve with white edge; no green above anal vein, or a vague median streak in specimens with the other green median shades large..... *auripes*

15. Uncus of male T-shaped.....16
Uncus of male merely sharply bent down; tegumen with a large right lateral process (in the position of the upper lobe of the valve in the first group).....17

16. Ventral valve of abdomen solid black; tegumen without any lateral process; median green area dim, diffuse except on the fine black veins, nearly as strong below A as above..... *sura*
Ventral valve with strong white edge (at least partly); green of median area brilliant, costal, the inner margin being solid black or at most with a few scattered green scales; lateral process small, far down on side..... *cyllarus*

17. Fore wing with green confined to the basal spots; abdomen below without subventral white dots..... *albitarsia*
Fore wing green on median area, at least toward costa.....18

18. Under side of abdomen without white markings..... *esmeralda*
Under side of abdomen with white edge of valve and subventral dots.....19

19. Upper side of abdomen suffused with metallic green, the stripes visible only at base.....20
Upper side of abdomen dull blackish in usual lighting, with narrow dorsal and lateral green lines.....21

20. Green on median area bright, streaky, more or less confined to costal portion..... *indistincta*
Green less brilliant, very smooth and diffuse, strong (except on veins) to inner margin..... *hampsoni*

21. Fore wing with median green area extensive, with a (usually separate) streak above A..... *alesa*
Fore wing with median green confined to costal half or less.. *vittata*

Fore wing with green less brilliant, and diffuse, covering practically whole width of wing..... *ockendeni*[1]

22. Apical area of fore wing heavily shaded below, and faintly above with white, between veins (♀)..... *hesione*
Apical area black like rest of wings.....23

23. Green areas of fore wing brilliant, tending to form median streaks between veins..... *nigritarsia*
Green of fore wing diffuse and faint, except the usual small basal spots..... *eacus*

[698 Macrocneme adonis Druce

M. adonis Dr. Biol. Centr. Am. Het. i, 48, 6: 16, 1884.
Also *figured:* Seitz 17: b2.

In all the males of this coloring, which I have seen, whether determined as *adonis*, *cyanea* or *maja*, the last segment of the tarsus is white, in the corresponding females it is black.

Range uncertain. *M. adonis* was described from Panama, *cyanea*, which should have a little wider black apex, from Rio and *maja* Hübner (in error) also presumably came from Rio. Hampson reports *adonis* from as far north as Cordova, Mexico.]

[739 Macrocneme aurata Walker

Euchromia (*Macrocneme*) *aurata* Wlk. List Lep. Ins. Br. Mus. i, 250, 1854.
M. semiviridis Dr. Ann. Mag. Nat. Hist. (8) vii, 287, 1911.
Figured: Hamps. fig. 155, Suppl. 11: 5 (as *semiviridis*); Seitz 18: b4, 28: f3 (as *semiviridis*).

Hind legs much broadened (Macrocneme, not Calonotos), with strong white tips. Easily distinguished from most other Macrocnemes by the very even and brilliant green patch, ending abruptly and not interrupted subbasally, the hind wing mostly green. The male genitalia (fig. 7) with left edge of juxta drawn out into a long process.

Chiriqui, Panama to Rio; a specimen from Chiriqui (Cornell) figured.]

[699 Macrocneme cinyras Schaus

M. cinyras Schs. Ent. Am. v, 88, 1889.
Figured: Biol. 71: Seitz 17: b2.

[1] Not examined, this form may prove conspecific with *M. sura*.

The Seitz figure is good. The male characteristically shows the green divided into four patches by a broad black band from near base of inner margin through cell to the black apical area crossed by one from costa near base along fold to the black apical area. When reduced the green still tends to show the same four areas. Genitalia unique (fig. 1) as indicated in key. I am uncertain of the female; Schaus had associated it with *adonis* but I think the latter belongs with the northern *cyanea*-like males that have a minute white tip to hind tarsus. The National Museum have a single female with the male pattern but more extended which is certainly correct, and others may be confused with *adonis*, but should differ in having the green areas all of one shade.

Mexico (type) and Central America. Tela, Honduras, Mar. 1936 (Deal) and Mackenzie, British Guiana (Forbes) in Cornell.]

700 Macrocneme chrysitis Guérin

Glaucopis chrysitis Guér. Icones Règne Anim. Ins. 502, 1844.
Figured: Biol. 6: 17 (as *iole*); Seitz 17: b4.

Green area on fore wing above with even transverse outer boundary before end of cell (not well shown in Seitz), extending except for fine black veins from costa to inner margin, interrupted with black near base (heavily in ♀). The band is usually brassy but clear green in the two Panama females at hand. Male genitalia normal for the group (fig. 2) juxta long, tapering to less than half its width at tip, and heavily spinulated.

Mar. 3 (Friedman), Mar. 9 (A.M.N.H.). Ranges north to Mexico. Hampson also reports this from southern Brazil, but the records should be verified.

In this species the under side of the hind wing is mostly green, as also in *M. thyra* and its Panama representative, — in *M. cinyras* it is confined to a costal stripe. *M. leucostigma* and *thyridia* tend to be intermediate, but vary.

704 Macrocneme thyra Möschler

M. thyra Msch. Verh. z.-b. Ges. Wien. xxxii, 334, 18: 24, 1883.
M. albiventer Dgn. Het. Nouv. xxiii, 2, 1923.
Also *figured:* Seitz 17: c1.

In the typical male this species is easily recognized by the almost wholly white under side; there is a form in which the white is less ex-

tensive, but the genitalia are essentially the same. The type form is before me in series from eastern Peru. Types of both names were the white phase from Guiana. Other specimens from Guiana, and the only one at hand from Panama have the white limited to the base of abdomen and only spots on the thorax, though much larger ones than in thyridia. Female indistinguishable from *thyridia* and *leucostigma*. Male genitalia (fig. 3) with juxta relatively short, squarely cut off basad of the point of origin of lower lobe of valve; left upper lobe of valve with a more or less distinct tooth on upper inner edge before tip.

Range uncertain, typical males seen from Guiana and Peru, dark ones from Guiana and Panama (Barro Colorado Id., Mar. 4, Apr. 10, Friedman).

705 Macrocneme thyridia Hampson

? *Zygæna maja* Fabr. Mant. Ins. ii, 106, 1787.
M. thyridia Hmps. Cat. Lep. Phal. i, 321, 11: 9; 1898.
M. lades Hmps. Cat. Lep. Phal. i, 317, 1898 (in part, not Cramer).
M. guyanensis Dognin, Hét. Nouv. ii, 6, 1911.
M. lades cabimensis Dyar, Proc. U. S. Nat. Mus. xlvii, 162, 1914.
M. euphrasia Schs. Proc. U. S. Nat. Mus. lxv, (7), 10, 1924.
Also *figured:* Seitz 17: d1.

The list of names is mainly due to variability in the amount of green, the median fascia being normally nearly complete, transverse and moderate; very narrow in *cabimensis* and mostly on inner margin in *guyanensis*. *M. cabimensis* may possibly belong to the preceding as the types are female, and both species have forms with very narrow green bands. The abdomen is sometimes strongly coppery, as in Seitz's figure, but I think this is due to age, all the fresh specimens seen having green abdomens. Male genitalia (figs. 4 and 5) with scoop extending rather beyond base of lower lobe of valve, narrowed and obliquely truncate. Uncus variable in detail, but always with a rounded central dorsal area and a pair of lateral flanges, the right one generally stronger. Left valve without inner tooth, rounded at tip.

Mar. 25, Apr. 23 (Fried.) July 10 (Banks). Honduras to Guiana and Amazons.

[696 Macrocneme leucostigma Perty

Glaucopis leucostigma Pty. Del. Anim. Art. 158, 31: 11, 1834.
M. ferrea Btl. Jour. Linn. Soc. Zool. xii, 371, 1876.
M. lades Hamps. Cat. Lep. Phal. i, 317, fig. 145 (in part, not Cramer).
Larva: Jörgensen, Zeits. Wiss. Ins.-biol. ix, 74; Hamps. Suppl. 205.

Almost identical in pattern and genitalia with the preceding, (fig. 6), but with one or two keels on middle portion of uncus instead of a rounded area. The left keel is constant, the right one weaker than the left and occasionally absent.

This may be the true *M. maja* of Fabricius, as the description fits and he had southern Brazilian material. More probably it was the preceding, or one of two or three still obscure related types. It is not *lades*, which had only a single small basal green spot, and the abdominal pattern of the second group.

Seen only from Southern Brazil and Paraguay.]

(M. CYANESCENS Dgn., XANTHOLOPHA Schs., APOLLINAIREI Dgn.

These three species are closely related, and belong to the second group, with ventral valve and without dorsal spots on first segment. They differ in small points of coloring only, and I suppose are closely related, perhaps merely color forms. Genitalia not examined, but apparently with simple, rather heavy valve. All are from Colombia).

701 MACROCNEME LACONIA Druce

Callicarus laconia Dr. Biol. Centr. Am. Het. i, 49, 6: 18, 1884.
Also *figured:* Seitz 17: b3; Hmps. fig. 146.

Green scaling on fore wing (except for basal spots) sparse and slight; uncus simply hooked. The female hind wing is fully scaled and I do not know how to distinguish it from *M. nigritarsia.* Hind tarsus black or partly yellowish.

Culebra, Jan., 1915, (Am. Mus.) Central America, type from Yucatan.

M. misitra and *laciades* have the same genitalia so far as can be seen, and may be merely color forms (see key). Both are from southern Mexico.

[710 MACROCNEME JALAPENSIS Schaus

M. jalapensis Schs. Ent. Am. v, 89, 1889.
Figured: Biol. 71: 7; Seitz 17: d3.

Differs from the remaining species with yellow tarsus in the absence of median green.

Mexico and British Honduras.]

709 Macrocneme auripes Walker

Euchromia (*Macrocneme*) *auripes* Wlk. List Lep. Ins. Br. Mus. i, 250, 1854.
Figured: Butl. Ill. Lep. Het. Br. Mus. i, 8: 4; Biol. 6: 15; Seitz 17: d4.

Very close to *M. nigritarsia* and *cyllarus*. Uncus bent a right angle, (fig. 9) but not T-shaped; right lobe of tegumen broad-triangular.

Flight scattering (see diagram, p. 101). Ranges north to Guatemala.

[711 Macrocneme chrysotarsia Hampson

M. chrysotarsia Hmps. Cat. Lep. Phal. i, 324, 1898, 12: 22.
Also *figured:* Seitz 17: d5.

Differs most conspicuously in the different green pattern, (not clear in the Seitz figure). The wings also seem thinner.

Taboga Id., Panama (type). Ranges to Venezuela (Nat. Mus.)]

[714a Macrocneme sura Schaus

M. sura Schs. Jour. N. Y. Ent. Soc. ix, 42, 1901.
Figured: Hamps. Suppl. 11: 8; Seitz 28: f9.

Green fairly bright, but without sharp outer boundary, and cut by the usual black veins. Male genitalia not strikingly different from *M. cyllarus* (fig. 13). I have received this under a ms. name, credited to Schaus, but believe it was not described.

Southern Brazil.]

718b Macrocneme cyllarus Druce

M. cyllarus Dr. Ann. Mag. Nat. Hist. (6) xviii, 29, 1896.
Figured: Biol. 71: 2.

This is superficially identical with *M. indistincta*, and was originally sunk to it by Hampson, but differs in the T-shaped uncus. (fig. 12). *M. indistincta* is from Colombia.

Flight scattering (see diagram). Ranges north to Mexico.

[716 Macrocneme albitarsia Hampson

Possibly *Sphinx lades* Cramer, Pap. Exot. i, 83: E, 1776.
M. albitarsia Hmps. Cat. Lep. Phal. i, 325, 1898, 12: 6.
Also *figured:* Seitz 17: e3.

This may be the true *M. lades* of Cramer, which had a similar solid black fore wing with green basal spot only and must have belonged to this group. More probably it is a distinct species. Male genitalia, fig. 14.

Venezuela, Guiana and Amazons.]

[715 MACROCNEME ESMERALDA Butler

M. esmeralda Btl. Jour. Linn. Soc. Zool. xii, 371, 1876.
Figured: Hamps. 12: 4; Seitz 17: e2.

Distinguished by the solid black color, with diffuse green on fore wing and white tip of hind tarsus only. The specimens at hand from Panama with this determination (in the Nat. Mus.) have white abdominal markings and black hind legs, and are doubtless females of *M. nigritarsia.*

Guiana and Amazons.]

712.1, 712a MACROCNEME HAMPSONI Schrottky

M. indistincta, ab. 1 Hmps. Cat. Lep. Phal. i, 324, 1898.
M. hampsoni Schrot. Iris xxiv, 151, 1910.

The Panama record is based on two females, which may be really suffused specimens of *cyllarus* or *laconia.* The true *hampsoni* was described from southern Brazil.

Apr. 1, 1927 (Frost, Nat. Mus.), Panama City (Shannon, N. M.), Panama (?) (Cornell), all females.

[713 MACROCNEME ALESA Druce

M. alesa Dr. Proc. Zool. Soc. 1890, 493.
Figured: Hamps. 12: 3; Seitz 17: d7.

A representative of the preceding, with dull black abdomen.

Venezuela to Bolivia and Para. A male in Cornell was received with Panama material. *M. vittata* Walker is a closely related species, covering Panama in its range. It has less green.]

717 MACROCNEME HESIONE Druce

M. hesione Dr. Ann. Mag. Nat. Hist. (6) ii, 239, 1888.
Figured: Biol. 71: 3; Seitz 17: f2.

Only females are known, and this is presumably a dimorphic form of some other species, possibly *eacus*.

Jan. 28 (Bts.) Chiriqui (type).

718 Macrocneme nigritarsia Hampson

M. nigritarsia Hmps. Cat. Lep. Phal. i, 326, 12: 24, 1898.
M. vittata Druce, Biol. Centr. Am. i, 48, 1884 (not Walker).
Also *figured:* Seitz 17: e6.

Wings with green pattern exactly as in *M. cyllarus*, and varying in the same way, but abdomen blackish with fine green lines only. Male genitalia as in *cyllarus* but right lobe of tegumen slenderer. (fig. 11).

Dec. 23 (Bts.). Mexico to Trinidad (Hmps.). Seen only from Honduras to Venezuela.

[719 Macrocneme eacus Stoll

Sphinx eacus Stoll in Cramer Pap.; Exot. iv, 129, 357: B, 1781.
Also *figured:* Seitz 17: e1.

Differs from the other small Macrocnemes by the light and diffuse green scaling, and black body, except for the usual small green basal spots. Male genitalia (fig. 10), much as in *M. nigritarsia*, the lateral lobe perhaps even longer.

Guiana and Amazons.]

Calonotos Hübner

Very close to *Macrocneme*, differing in the more closely parallel M_2 and M_3 of fore wing and simple hind tibia.

734 Calonotos tiburtus Cramer

Sphinx tiburtus Cr. Pap. Exot. iii, 75, 237: C, 1780.
Also *figured:* Seitz 17: i4 ♂, 5 ♀; Hamps. fig. 154.

Abdomen except first segment, striped with copper and black. In the male there is one outer spot on fore wing, or a second small one, in the female two equal spots. The male crumples the fore wing at rest, so that it appears notched, but the border is actually even.

Chief flight in Feb. (see diagram, p. 101). Costa Rica to Guiana.

Subfamily CTENUCHINÆ

In this group there is little tendency for Cu_1 and Cu_2 to be stalked or even approximate, and M_2 is never atrophied. In a few cases M_2 is stalked with M_3 or even lost by fusion, but in that case Cu_1 and Cu_2 are always widely separated. The usual Euchromiine larva, with heavy lateral pencils on 1st and 8th segments of abdomen, occurs here, but as often these pencils are absent. The Ctenucha group have a row of short dorsal pencils, like the Phegopterini.

Generic groups are not yet clearly defined, but there is a transparent winged type (*Argyroïdes* and *Dinia*), groups centering around *Ceramidia, Napata* and *Ctenucha,* and a primitive type with the base of Sc preserved (*Eucereon, Episcepsis,* etc.) the latter not grouped in our present arrangement. The Horama group (with Cu_1 and Cu_2 stalked) have not yet been taken in the Zone.

Dinia Walker

A striking little type, sometimes abundant locally. There are three closely related species, all with transparent fore wings with slender border and veins and heavier discal bar, and broad round hind wing with wide border. Cocoon on a twig, protected by palisades of the larval hairs.

746 Dinia mena Hübner

Eunomia mena Hübn. Samml. Exot. Schm. ii, 368 (Kirby's numbering), 1823. Also *figured:* Seitz 18: c2.

Smaller and more delicate than *D. œagrus,* with a variable amount of red at base of fore wing and very little or no blue.

Feb. 6, 12 (A.M.N.H.), July-Aug. (Fairchild). Ranges south to Argentina.

Trichura Hübner

The general body shape and coloring suggest the Polistes-Polybia type of wasps, but the long anal process of about half the species is more ichneumon-like.

The American Museum of Natural History has two species from the Canal Zone — *T. latifascia* Wlk. (*ismene* Mösch.), with faintly yellow wings, heavy discal bar and long anal process in male, and *T. druryi* Hbn. with deep yellow wings, linear discal bar and no anal process.

Marecidia Schaus

Hampson's characterization (Suppl. p. 256, fig. 37) is not wholly accurate. The peculiar shape of the body suggests close connection with Trichura.

Antennæ prismatic, the shaft much widened on middle portion; palpi upturned, with third joint tapering, short and porrect (suggesting Cisseps).[1] Hind tibia of male much enlarged, with a scale-tuft on inner face, of female normal; abdomen somewhat constricted on third segment, with a pair of terminal tufts but no lateral ones. Fore wing fully scaled, narrow-triangular, with R_5 stalked only a little beyond R_2, M_1 well separated, M_2 a little separated from the connate M_3 and Cu_1, Cu_2 far back; hind wing very small, less than half as long as fore wing, with anal area reduced and transparent; R and M_1 connate (stalked according to Hampson in M. sanguipuncta) M_2 a little separated, M_3 and Cu_1 connate, Cu_2 more than 3/4 way out on the short cell.

The two species are closely related, but the fore wing of *M. sanguipuncta* is brilliant green.

Marecidia achrysa new species

Similar to *M. sanguipuncta* Schs., but the fore wing dull, and the red spots much larger.

Black; head and palpi dull green; thorax with large dull green patches on collar, shoulders, tegulæ above and scutellum, the patches not quite meeting; abdomen with a double dorsal series of large patches; terminal tuft and under side with iridescence deeper, bluer, less bright and diffuse. White spots on fore coxæ, hind (but not middle) trochanters, tips of hind femora, sides of metathorax, — venter of first three segments of abdomen white, followed by white spots in male, the spot on 7th segment larger in male or alone present in female. Fore wing above deep black, with a green basal spot only, a deep crimson elliptical spot below cell, extending from 1/5 to 3/5 the distance to the fork of Cu_2; hind wing with costal half covered with dull brown sex-scaling in male, the female with a whitish spot in cell; scaling becoming sparse dorsally; the inner margin transparent. Under side of fore wing above fold and most of hind wing suffused with deep iridescent blue; a red spot on upper outer part of hind wing. Femora and tibiæ deep green, tarsi dull black. 30 mm.

[1] Scepsis Walker 1854, not 1850.

Barro Colorado Id., Panama, May, 1, 2, 28, June 6, 24, Dec. 31 (types in Museum of Comparative Zoölogy), Nov. 22, Feb. 11, Mar. 14, (Am. Mus. Nat. Hist.).

Æthria sarcosoma Butler is represented in the M.C.Z. from Taboga Id., and in the American Museum from Ancon, C. Z. It is much like Dinia, but smaller, with the whole outer part of the abdomen dominantly carmine.

Argyroeides Butler

A genus of small, extremely wasp-like, moths. They are superficially identical with the first group of Euchromiinæ, but differ in the free Cu_2, and also in the formation of the waist, where the second segment as well as the first is involved, and the tympanic hoods are not modified.

1. Black, the constricted part of abdomen moderately narrowed, pale yellow..... *minuta*
   Black and yellow in fairly equal proportions, striped, the waist extremely narrow..... *menephron*

781 Argyroeides menephron Druce

A. menephron, Dr. Biol. Centr. Am. Het. i, 65, 8: 14, 1884.
Also *figured:* Seitz 19: a5.

Wings transparent, yellow tinted; costa fully scaled. Orange streaks on costa and shaft of antenna.

Jan. 13 (Bates), June 18 (Friedman). Described from Panama.

The American Museum has *A. minuta* Dr. (Biol. 72: 3; Seitz 19: c3) from Corozal, C. Z. (Curran), and the National Museum from Tabernilla.

Hypocladia Hampson

Superficially like Delphyre, but the wings more pointed, and with no trace of the rudimentary Sc so common in the Eucereon group.

800a Hypocladia restricta Hampson

H. restricta Hmps. Ann. Mag. Nat. Hist. (7) viii, 172, 1901.
Figured: Hamps. Suppl. 12: 5; Seitz 28: i4.

The red lateral stripe runs from the prothorax under the base of the wings across the first abdominal segment (not the first two as Hampson

states). *H. militaris* Btl. from the Amazons is closely related, but the red stripe is longer.

Principal flight at end of Jan. (see diagram, p. 101). Only known from the Canal Zone; the other two species of this group are apparently equally restricted, *parcipuncta* from Guiana, and *militaris* from the Amazon.

Eumenogaster Herrich-Schäffer

Near Chrysostola but with basal half of *third* segment rather strongly constricted and marked with white; the wings more pointed. The following species appears in Hampson as a Chrysostola.

840 Eumenogaster moza Druce

Argyroeides moza Dr. Ann. Mag. Nat. Hist. (6) xviii, 32, 1896.
Figured: Biol. 72: 4; Seitz 19: k7.

Black with white spots on body and red terminal tuft; wings deeper yellow than in Chrysostola, with scarlet costal stripe.

Jan. 5 (Bts.) Feb. 16, Mar. 17 (A.M.N.H.) 21 (Fried.), July 15 (Banks). Described from Chiriqui.

Metastatia Butler

A broader winged type than the neighboring genera, with waist not narrowed, — presumably modified by mimicry of the Ithomiinæ. Hind tibia swollen, but less than in Marecidia.

823 Metastatia pyrrhorhea Hübner

Hipocrita chrysorrhea Hübner, Erste Zutr. (nomen nudum validated by publication of the Zuträge figure before 1814).
Hyelosia pyrrhorhea Hübner, Zutr. Exot. Schm. i, 12, figs. 43–44, 1818 (date of publication of name, according to Hemming.)
Also *figured:* Hamps. f. 183; Seitz 19: h1.

The Erste Zuträge name is undoubtedly valid, but has had no usage whatever, and had better be forgotten. It was doubtless changed as being preoccupied by *chrysorrhea* Linn., in the same Linnæan subgenus.

Transparent, slightly bluish; with broad black borders and band across fore wing, and red tail.

Jan. 1, 1929 (Curran, Am. Mus. Nat. Hist.). Costa Rica to Guiana and Amazons.

Cacostatia sapphira is startlingly similar, but has two dorsal veins stalked in hind wing.

Syntrichura Butler

Similar to Chrysostola; abdomen moderately constricted on second and third segments, marked with narrow dorsal and wide lateral white patches so as to appear much more slender than it is. Both wings with M_2 and M_3 completely united.

812.1 Syntrichura reba Druce

S. reba, Dr. Ann. Mag. Nat. Hist. (6) xviii, 33, 1896.
Figured: Biol. 72: 7.

Black and blue with transparent wings, sides of thorax red; fore wing with narrow border and discal bar, hind wing with apex black.

Feb. 6 (Gertsch, A.M.N.H.). Chiriqui and Colombia.

Chrysostola Herrich-Schäffer

Abdomen hardly constricted in the present species, more strikingly so in *C. zethus* (Hamps. fig. 184).

The name *Abrochia* H.-S. has "page priority," but is not in general use; it was revived in the Lep. Cat. and Seitz.

1. Body yellow, with narrow black markings, the terminal half more orange. Fore wings with orange streaks below costa and toward inner margin; veins of hind wing black. . . . . *fulvisphex*
   Body yellow, the head, prothorax and tail black and blue; veins of antemedial portion of fore wing and most of hind wing light yellow, contrasting with the black remaining portions 2
2. Smaller; anterior part of thorax, tegulæ and hoods yellow. . *augusta*
   Larger; whole thorax and hoods black. . . . . *mellita*

826a Chrysostola mellita Schaus

C. mellita Schs. Ann. Mag. Nat. Hist. (8) vii, 180, 1911.
Figured: Hamps. Suppl. 12: 22; Seitz. 19: i1.

The yellow veins go practically to the base of the wing; in the female the discal spot is large and round.

Jan. 3 (Bts.), Feb. 9 (A.M.N.H.), Apr. 3 (Fried.), July 24 (Fairchild), 31 (Banks). Costa Rica.

827 Chrysostola augusta Druce

Dycladia augusta, Dr. Biol. Centr. Am. Het. i, 62, 7: 19, 1884.
Also *figured:* Seitz 26: k2 (much enlarged). (*Not* 19: h).

The apical black border is very narrow.

Nov. 29 (Bts.), Feb. 8 (A.M.N.H.), July 25 (Banks). Guatemala (type).

837 Chrysostola fulvisphex Druce

C. fulvisphex, Dr. Ann. Mag. Nat. Hist. (7) i, 404, 1898.
Figured: Hamps. 13: 13; Seitz 19: k4.

Mar. 23 (Friedman). Guiana and Amazons.

Ecdemus Herrich-Schäffer

Apparently close to the North American Cisseps, but with closer held palpi and smoother front. The present species would go by venation in Teucer, but differs in the loss of the rudimentary Sc and narrow costal area of hind wing. "*Teucer*" *carmania* Dr. is close.

841b Ecdemus obscurata Schaus

E. obscurata Schs. Ann. Mag. Nat. Hist. (8) vii, 180, 1911.
Figured: Hamps. Suppl. 12: 27; Seitz 28: n2 ♂.

Male with disc of both wings transparent, female with only hind wing.

Dates scattered (see diagram, p. 101). Costa Rica (type).

Pterygopterus Butler

Apparently an offshoot of the Ceramidia group; the valve is small, but edged with white.

852 Pterygopterus leucomela Walker

Automolis leucomela Wlk. List Lep. Ins. Br. Mus. vii, 1636, 1856.
Figured: Biol. 8: 7; Seitz 20: a4.

Body marked with blue, with pale lateral spots on third segment; apical fifth of fore wings white.

Oct. 26, Nov. 26 (Bts.), Jan. 3 (Curran, Am. Mus. Nat. Hist.). Ranges to Para.

Episcepsis Butler

A derivative of Eucereon, as shown by the preservation of Sc, but with much reduced markings. The males of most of the species have hair pencils at the inner margin of the hind wing, above, below or both, but they are concealed in deep folds and often hard to bring out. The following key is the best I can make using only bisexual characters, but may fail occasionally.

The larva of *E. phlebitis* is in the National Museum. It is pale yellow, with a group of black dorsal spots in each segment except metathorax where there is a red spot. Hair fine and soft, with only a weak lateral pencil on first segment of abdomen.

1. Fore coxæ pink.....2
   Fore coxæ white.....7
2. Ground gray, with contrasting dark border and veins.....*venata*
   Ground dark without dark border or strongly contrasting veins.3
3. Red prothoracic spot on outer edge of patagium (tergite); male with slight angle and pencil at inner edge of hind wing above; fore wing concolorous dark.....*lamia*
   Red prothoracic spot on pleura only.....4
4. Fore wing with a white apical patch; anal lobe of hind wing strong with a massive yellow pencil above; fore wing with veins rather paler, the white on under side of body and hind wing often rather weak.....*lenæus*
   Fore wing without apical white patch.....5
5. Lobe at anal angle strong; pencil strong, veins of fore wing somewhat paler.....*lenæus*, var.
   Lobe at anal angle weak; veins of fore wing concolorous or somewhat darker.....6
6. Larger; male with white pencil below; under side of hind wing in both sexes and of abdomen in female blackish.....*hypoleuca*
   Smaller; hind wing with a groove but no pencil below; under side of hind wing with a large white patch in male, reaching inner margin, of abdomen white in both sexes.....*frances*
7. Vertex with a pair of red spots; prothorax with one, rarely two red spots on side; male with slight anal lobe and pencil below; fore wing with dark veins, and no white apex.....*gnomoides*

Vertex with markings yellow and normally more extensive, the halves of collar more or less outlined with yellow; veins of fore wing pale; the apical third with a white patch; hind wing without lobe and pencil; under side blackish in both sexes. . . *capysca*

GROUP I: *Male with anal lobe large, and hair-pencil massive, on a special support.*

856 EPISCEPSIS LENÆUS Cramer

Sphinx lenæus Cr. Pap. Exot. iii, 95, 248: G, 1780.
Also *figured:* Seitz 20: b1.
Larva: Stoll in Cr. Pap. Exot. v, 15: 4–6, 1790 (as *leneus*).

Generally distinguished by the pink coxæ and white apex. In one specimen the white apex is almost completely obscured, but it is a male, and recognizable by the massive white hair pencil.

Oct. 30-Mar. 15. Mexico to Guiana. Cuba.

Larva according to Stoll on cotton, Halysidota-like, with long subdorsal and shorter lateral tufts on 1st and 8th segment of abdomen, short dorsal tufts on middle segments and a few clubbed hairs. Varicolored, the thorax dominantly yellow, the rest more red-brown and black.

GROUP II. *Hind wing of male slightly lobed, with pale hair-pencils above, below or both.*

862 EPISCEPSIS HYPOLEUCA Hampson

E. hypoleuca Hamps. Cat. Lep. Phal. i, 388, 14: 4; 1898.
Also *figured:* Seitz 20: d4.

A massive pencil beneath.

Dec.-Mar., July-Aug.; Lancetilla, Honduras (Bates) commoner than in Panama, Mar.-May. Described from Venezuela.

862a EPISCEPSIS FRANCES Dyar

E. frances Dy. Proc. U. S. Nat. Mus. xxxviii, 230, 1910.
Figured: Hamps. Suppl. 13: 3.

The species has a specially scaled groove on under side but I can find no pencil in it.

Oct. to Apr.; Lancetilla, Honduras (Bts.). Mexico to Guiana and Peru.

860 Episcepsis lamia Butler

Heliura lamia Btl. Ill. Lep. Het. Br. Mus. i, 44, 16: 3, 1877.
Also *figured:* Seitz 20: c1.

The lateral spot on prothorax is lower than usual, leaving a distinct space between it and the collar spot. *E. dodaba* Dyar, placed by Hampson as a synonym of *inornata*, seems rather to be a form of this with reduced collar-spots. Pencil above.

Nov. 24 (Bts.), Mar. 30 (Fried.) Described from Amazons.

859a Episcepsis gnomoides Schaus

E. gnomoides Schs. Ann. Mag. Nat. Hist. (8) vi, 190, 1910.
Figured: Hamps. Suppl. 13: 1; Seitz 28: 11.

The anal lobe is very weak and I can find a hair pencil only below.

Mar. 15 (A.M.N.H.); July-Aug. (Fairchild, U. S. Nat. Mus.), (Schaus det.). Described from Costa Rica.

863 Episcepsis venata Butler

E. venata Btl. Ill. Lep. Het. B.M. I, 49, 16: 7, 1877.
Also *figured:* Seitz 20: d5.

Light luteous, with contrasting black border, veins and discal bar. The present specimen is paler and more contrasted than Seitz's figure.

Mar. 17 (A.M.N.H.) 1♀. Mexico to Amazons.

Group III. *Hind wing not at all lobed at anal angle, without a hair-pencil.*

857a Episcepsis capysca Schaus

E. capysca Schs. Ann. Mag. Nat. Hist. (8) vi, 190, 1910.
Figured: Hamps. Suppl. 12: 31; Seitz 28: 12.

The pale streaks are stronger and the yellow on the head more extensive than in the other species known to me. *E. capyscoides* Schs. from Guiana is very close but has less yellow. Hampson, lacking males, placed both by mistake in the group with lobe and pencil.

Nov. 2, 30, Dec. 23, Mar. 5, 17, July-Aug. Costa Rica (types).

Androcharta Felder

The peculiar pattern of fore wing and much reduced hind wing give this genus a distinctive appearance. In nature the male hind wing is entirely concealed by the fore wing except the minute anal area, and the whole moth looks Dipterous.

869 Androcharta meones Stoll

Sphinx meones Stoll in Cr. Pap. Exot. iv, 73, 325: E, 1780.
Also *figured:* Sepp. Surin. Vlinders i, 81, 37, 1848 (as *Glaucopis compta*); Herrich-Schäffer, Aussereur. Schm. fig. 237 (as *Charidea meonioides*): Hamps. fig. 198; Seitz 20: e1 ♂ ,2 ♀ .
Larva and *pupa:* Sepp, l.c.

Shoulder white, red streak on costa and middorsal spots on abdomen. Male hind wing very short and small, white above except the minute anal lobe.

Larva pale yellowish, with massive lateral tufts on 1st and 8th segments of abdomen and scattered longer hairs or small pencils on the same segments; pupa light brown, shining. Food Paullinia and Inga.

July-Aug. (Fairchild). Ranges to Guiana.

Ceramidia butleri Möschler is in the American Museum from Balboa, Nov. 14, 1914 (Seitz 20: g3). It is black and green, with a red streak deep in groove of neck. Larva apparently on banana.

Amycles "Herrich-Schäffer" [1]

Male with R_5 arising from stem of R about 2/3 way from end of cell to apex. Hardly distinct from Ceramidia Btl.

884 Amycles anthracina Walker

Euchromia (Anycles) anthracina Walker, List Lep. Ins. Br. Mus. i, 253, 1854.
Figured: H.-S. Aussereur. Schm. 259; Butler Ill. Lep. Het. Br. Mus. i, 9: 7; Hamps. fig. 201; Seitz 20: i4.

[1] The name Amycles is in a fantastic tangle. In 1854 Walker proposes it as new ("MSS."), as a subgenus with the spelling "*Anycles*". Later he refers back to it as "*Amycles*" without comment (vii, 1633). Herrich-Schäffer first proposes *A. anthracina*, apparently as new, in 1855 (date according to Horn and Schenkling for the plate). His earliest text reference to this is under the generic name *Eriphia* "HV" (but Eriphia of Hübner's Verzeichniss is a Fabrician species, the genus name being Antichloris). Later he writes "Amycles Bd., Eriphia HV", but I cannot find any use of the name by Boisduval. Nomenclatorially it would appear we must write "Anycles Walker", but Amycles is in current use, following Hampson.

Deep brown with some crimson scales in neck; apices of fore wings whitish; first segment of abdomen white-edged below, with a small valve in male.

Balboa, July-Sept. (Hallinan, Am. Mus. Nat. Hist.) Mexico to Brazil.

Leucopleura Hampson

Distinguished from Amycles and Ceramidia by the stalking of R_2 with R_1 instead of R_3, M_2 of hind wing from lower angle of cell, and transparent markings. The pattern is a common one in the Upper Amazon Basin, black, blue and transparent, and is found in members of all the main groups of the family. The other species has the transparent areas more extensive and less blue on the hind wing.

Leucopleura ciarana Schaus

L. ciarana Schs. Proc. U. S. Nat. Mus. lxv (7) 12, 1924.

Black shot with blue, two single transparent spots on fore wing and a double one representing the m. fascia, hind wing blue with a transparent streak below cell and double outer spot.

Tabernilla, Panama, type only.

Atyphopsis Butler

Similar to Napata; wings broad and translucent, M_2 and M_3 stalked in both wings.

893 Atyphopsis modesta Butler

A. modesta Btl. Trans. Ent. Soc. Lond. 1878, 49.
Figured: Hamps. fig. 208; Seitz 21: b3.

Gray, head black and orange-red; thorax gray and orange; middle of abdomen orange; wings dark-veined.

Feb. 17, Mar. 9 (A.M.N.H.). Costa Rica, Guiana, Amazons, etc.

Napata Walker

An extremely varied genus, probably related to Ctenucha, and without any very striking specializations.

1. Yellow, marginal area streaked with black and white..... *walkeri*
   Blue-black, body with blue dorsal stripe, wings with white spots. 2

2. Larger; fore wing with white postmedial spot, hind wing with transparent disc..... *flaviceps*
   Smaller, fore wing with base and disc transparent, hind wing opaque..... *leucotelus*

899 Napata walkeri Druce

Evius walkeri Dr. Ann. Mag. Nat. Hist. (6) iv, 86, 1889.
Figured: Biol. 73: 21; Seitz 21: c3.

Obviously mimetic; the pattern recurs in the Pyralid, *Mapeta xanthomelalis*.

Dec. 4 to Mar. 26. Also Costa Rica, Chiriqui and Taboga Id. (type).

912 Napata leucotelus Butler

N. leucotelus Btl. Jour. Linn. Soc. Zool. xii, 409, 1876.
Figured: Biol. 7: 24; Seitz 21: f2.

Head and front of thorax solidly green-blue; extreme tip of fore wing and inner fringe of hind wing white.

Jan. 17 (Bates). Lancetilla, Honduras, Aug. (Bts.). Mexico to Venezuela.

917b Napata flaviceps Hampson

N. flaviceps Hmps. Ann. Mag. Nat. Hist. (7) viii, 173, 1901.
Figured: Hamps. Suppl. 14: 25; Seitz 29: e6.

Vertex and sides of prothorax yellow, upper face white; hind wing much bluer than fore wing.

Nov. 14; Feb. 1 (Bts.), Mar. 17, June 16 (Fried.). Described from the Canal Zone (La Chorrera). Costa Rica and Colombia (U. S. N. M.)

Aclytia Hübner

Fore wing with R_2 free, hind wing with a rudiment of Sc and costa broad at middle; M_3 and Cu_1 stalked; fore tibia of male with a hair-pencil. Simply marked, usually with a yellow or white spot or transverse bar on fore wing and transparent disc on hind wing.

1. Band of fore wing white; markings of under side of body white, but back of head, palpi and collar with yellow ..... *albistriga*
   Band or spot on fore wing yellow; stripe on under side concolorous with head markings.....2

Band on fore wing absent; abdomen with yellow bar below; collar and shoulders with paired orange-red dots..... *ventralis*

2. Markings on under side of thorax and stripe on abdomen pure white; palpus marked with white, the head with traces of white scaling..... *punctata*

Stripe on under side yellow, continuous from thorax, where it is formed mainly of the coxæ; head with yellow markings on vertex, palpi and collar.....3

3. Both sexes with yellow fascia across fore wing..... *gynamorpha*

Male with a round middle costal spot..... *heber*

1007a Aclytia albistriga Schaus

A. albistriga Schs. Ann. Mag. Nat. Hist. (8) vi, 191, 1910.
Figured: Hamps. Suppl. 15: 29; Seitz 29: k1.

The black is intense and the blue body very bright in this species. Feb. 4 (Bts.) ♂; Costa Rica, unique ♀ type.

1009 Aclytia punctata Butler

A. punctata Btl. Jour. Linn. Soc. Zool. xii, 414, 1876.
Figured: Hamps. 15: 12; Seitz 23: e3 (♂ var. *astigma* Strand).

Male typically with a small yellow spot near middle of costa, rarely absent (var. *astigma* Strd.) or extended to inner margin (var. *megastigma* Strd.). Female with the complete fascia, but variable in width.

Apr. 22 (var. *megastigma*) and 26 (Fried.) Lancetilla, Honduras (Bts.). Ranges south to the Amazons.

1011 Aclytia gynamorpha Hampson

A. gynamorpha Hmps. Cat. Lep. Phal. i, 457, 1898.
Figured: Butler Ill. Lep. Het. Br. Mus. i, 8: 3 (as *flavigutta*); Seitz 23: e6 ♂.

Both sexes with a broad yellow fascia on fore wing.

Dec.-Mar. Lancetilla, Honduras (Bts.) Amazons (type) Surinam (Cornell).

1012 Aclytia heber Cramer

♂ *Sphinx heber* Cr. Pap. Exot. iii, 169, 287: A, 1780.
♀ *Sphinx halys* Stoll in Cr. Pap. Exot. iv, 129, 357: C, 1787.
Also *figured:* Hamps. fig. 245; Seitz 23: f1 ♂, 2 ♀, 3 (ab. *insignata* Ddt.).

Female not certainly distinguishable from *A. gynamorpha,* but normally with much broader yellow band.

July-Aug. (Fairchild). Also reported by Dyar from the Zone, but both records based on females and so not quite certain. Mexico to southern Brazil.

1013 Aclytia ventralis Guérin

Glaucopis ventralis Guér., Icones Règne Anim. Ins. 503, 1844.
A. conspicua Dr. Biol. i, 70: 8: 23, 1884.
Also *figured:* Seitz 23: f4.

July-Aug. (Fairchild). Ranges to Mexico.

Mydromera notochloris Bdv. (Seitz 23: i5, as *isthmia* Fld.) was taken in the Canal Zone by Hallinan (A.M.N.H.). It is black and blue with a narrow translucent stripe on each wing.

Delphyre Walker (*Neacerea* Hampson, with *Mesocerea* Hampson and *Ptychotrichos* Schaus)

This genus is close to Eucereon, differing definitely only in the complete fusion of M_3 and Cu_1 of the hind wing, and even this character is variable in *D. atava.* Mesocerea is supposed to differ in the wider separation of M_2 from M_3–Cu_1 in the hind wing, but the character varies individually and the appearance is homogeneous. The radial venation also varies occasionally, R_1 being stalked, or R_2 free. M_2 and M_3 of fore wing may be connate or more or less stalked.

1. Plain brown without markings; fore wing with M_3 and Cu_1 stalked, anal angle of hind wing of male with pointed lobe and pencil. 2
   Fore wing and thorax with definite patterns; M_3 and Cu_1 separate; hind wing without lobe and pencil. 3
2. Expanse 24 mm.; female light wood brown. . . . . *hebes*
   Expanse 16 mm.; female fuscous like male. . . . . *clachia*
3. Abdomen and hind wing mostly yellowish, fore wing gray with brown spotting. . . . . *cumulosa*
   Abdomen mostly scarlet; fore wing with quadrate blackish spots nearly in contact, leaving the veins and transverse lines pale, and also a broader pale patch below cell and postmedial line. *aurorina*
   Abdomen mostly blackish. 4

4. Under side of abdomen with a yellow patch on four middle segments, also head and fore coxae yellow; fore wing fuscous with darker veins, and paler shade below cell, and transverse postmedial fascia..... *flaviceps*

Under side of abdomen dark, above blue, underside of thorax scarlet; fore wing evenly blackish above..... *atava*

Under side of body somewhat diffusely whitish, above with scarlet lines on incisures, often almost completely hidden, fore wing with large quadrate spots, but antemedial region below cell with fine curved dark lines..... *rubricincta*

1057 Delphyre rubricincta Hampson

Neacerea rubricincta Hmps. Cat. Lep. Phal. i, 479, 16: 5, 1898.
Also *figured:* Seitz 24: c5.

Fore wing with R_1 free, R_2 stalked nearly to origin of R_5, M_2 and M_3 shortly stalked; hind wing with M_2 barely separated. Hind wing black with a group of translucent white discal patches between veins.

The nearest species to this seem to be *rhodocrypta* and *phœosoma,* but both have a pair of thick antemedial patches below cell, instead of the 3–5 lines, *phœosoma* is also much more brightly colored, with some red.

Main flight in Oct. to Feb. (see diagram, p. 101). Described from Taboga Id. Venezuela (Nat. Mus.).

Delphyre aurorina new species

Fore wing with R_1 stalked, M_2 and M_3 strongly stalked (*Ptychotrichos* of Hampson); hind wing with M_2 well separated.

Head, thorax and first segment of abdomen blackish; head yellow behind, shading into scarlet toward neck; sides of collar lobes finely edged with orange; posterior edge of scutellum yellow, but metathorax blackish. Abdomen scarlet, with black lateral stripes and terminal segment; beneath paler, shading into whitish in front, and with two black terminal segments. Fore coxae pink, femora and underside of thorax diffusely whitish. Fore wing almost covered with quadrate blackish spots, separated in most parts only by the fine pale veins and lines. A yellow basal spot; then five blackish bars between veins, the two in fold shorter and leaving a whitish antemedial patch, which is continuous with a squarish spot in cell and bar to inner margin. Medial fourth blackish, cut by the pale veins and a pale bar from Cu_2

to inner margin, and followed by a white fascia from R_5 to Cu_1, whose second spot is largest and 3rd and 4th offset a little outward, the last continued by a light gray line to Cu_2. Outer part similar, the upper portion bisected by a pale gray st. line down to M_2; extreme apex white, anal fringe cut with white. Hind wing translucent white, with black border almost half width of wing and broadly continued to base on inner margin. Under side of fore wing black, except for white spots in and below cell, and four pm. ones corresponding to those of upper side. Hind wing as above. 25 mm.

This may possibly be the unknown female of *D. maecila* Dgn. (Hamps. Suppl. fig. 44, Seitz 24: e4) but the sexual dimorphism would be unusual, especially the contrast of pink coxæ and scarlet vertical spot, and the larger antemedial white patch.

Barro Colorado Id., Panama, Nov. 30, 1934 (Bates), Holotype, Jan. 24, Feb. 2 (Friedman), paratypes, all females.

1064 Delphyre atava Druce

Heliura atava Druce, Biol. Centr. Am. Het. i, 74, 1884.
Ptychotrichos episcepsidis Dyar, Proc. U. S. Nat. Mus. xlvii, 163, 1914.
Figured: Hamps. 16: 24; Seitz 24: f1.

Venation highly variable, R_1 free or stalked; M_3 and Cu_1 of hind wing united (male) or stalked (usually in female). Blackish; abdomen mostly blue; two dorsal crimson spots on head and all coxæ crimson, but no stripe on abdomen. Male hind femur swollen, with a white pencil.

Feb. 27 (Friedman) 1 ♀. The types of both names were from the Canal Zone.

1064b Delphyre flaviceps Druce

? *Heliura testacea* Druce, Biol. Centr. Am. Het. i, 74, 1884 (♀).
Figured: Hamps. 16: 6; Seitz 24: f3.
Neacerea flaviceps Druce, Ann. Mag. Nat. Hist. (7) xv, 463, 1905 (♂).
Figured: Hamps. Suppl. 17: 13; Seitz 30: b4.

Male (*flaviceps*) a little paler than supposed female (*testacea*) and the black veins therefore more contrasting.

May 7 (Friedman). Described from Venezuela (*flaviceps*) and Guatemala (*testacea*).

Dyar describes *Delphyre elachia* and *cumulosa* from the Canal Zone (Proc. U. S. Nat. Mus. xlvii, 163) and also reports *D. hebes* Walker (Hamps. Suppl. 16: 21).

Heliura Butler

Hardly distinct from Eucereon, the separation of M_2 and M_3-Cu_1 varying individually. But the present species are apt to be more spotty looking.

1. Abdomen pink ..... *balia*
   Abdomen dark 2
2. Abdomen brown, with apical half yellow ..... *maculosa*
   Abdomen black, with minute white tip ..... *banoca*
   Abdomen bright blue, without pale tip ..... *Delphyre atava*

1086, 1069b Heliura balia Hampson

Eucereon balium Hmps. Cat. Lep. Phal. i, 494, 1898; *Heliura b.* Hmps. Suppl. i, 308, 1914.
Figured: Hamps. 16: 13; Seitz 24: g2.

Fore wing with R_2 long-stalked, in one specimen beyond origin of R_5, M_2 and M_3 stalked, hind wing with M_2 arising pretty close to $M_3 + Cu_1$.

Hind wing without sexual modification; spotting of fore wing gray; abdomen pink to base, continuous with the yellow scutella. Under side of thorax with a little pink on coxæ only.

Nov. 25, Dec. 7, Feb. 1, May 6. Guatemala to Colombia (Nat. Mus.).

1059 Heliura maculosa Hampson

Neacerea maculosa Hmps. Cat. Lep. Phal. i, 479, fig. 265, 1898.
Also *figured:* Seitz 24: e7.

Fore wing with dark spots well contrasted and brown, especially the basal ones, which are rounded; abdomen with brown base tapering to a point on 4th segment and followed by dots on 5 and 6, and a larger spot on 7 and 8. Under side with a yellow stripe.

Hampson treats this as a *Neacerea* (*Delphyre*) and figures it with a vein missing; in all the specimens at hand M_2 is well separated and M_3 and Cu_1 are stalked.

Dec., Jan., Mar. June, July-Aug. Described from Para.

Dyar describes *Heliura banoca* from the Zone. Fore wing with black spotting almost confluent, leaving translucent white areas; abdomen black above, white below in male.

Eucereon Hübner

Palpi upturned to vertex, closely held; abdomen shaggy above toward base; fore wing with R_2 stalked, M_2 and M_3 frequently stalked; hind wing normally with a stub of Sc, R and M_1 connate or slightly stalked; M_3 and Cu_1 normally short-stalked, M_2 from their base, or very close.

The complex pattern of this genus frequently shows the normal moth elements (ante- and postmedial lines, orbicular and reniform spots, etc.) It is perhaps the most primitive of the family (unless the patterned species of Hyaleucerea). Heliura, Delphyre, Episcepsis and Aclytia may be derived directly from this genus or Hyaleucerea; in fact some specimens of *D. atava* show the structure of Eucereon (while the pattern would be more normal for Episcepsis). The species are numerous, and doubtless more will be taken on the Island, — four of the present list were taken after the preparation of this report was well under way.

The larva of *E. carolina* H. Edw. is black with flesh colored warts, and black, gray and white hairs, the longer hairs at the ends white-tipped. The young caterpillar is pale. It was reared on Philibertia and Vincetoxicum (Apocynaceæ).

1. Abdomen metallic blue above 2
   Abdomen not metallic 3
2. Fore wing with a complex pattern in white scales ..... *obscurum*
   Fore wing immaculate ..... *Delphyre atava*
3. Abdomen gray, with at most the terminal segment yellow 4
   Abdomen with at least the sides of the 4th to 7th segments yellow or pink, or subterminal segments shaded laterally with cream .. 7
4. Fore wing with broad gray vein-streaks, but without normal transverse lines; the white or cream postmedial spot beyond the cell not crossed by dark lines 5
   Fore wing with lines finer and black, crossing the postmedial area at least part way; ante- and postmedial lines normal in character, at least partly gray 6
   Fore wing fuscous, with confused markings and black discal dot. *pometinum*
5. Smaller; white postmedial patch broadly oval, not constricted; head above with two well separated deep yellow spots. *intranotata*
   Larger; postmedial patch narrow, lunate; head dorsally solid yellow ..... *phœoproctum*

6. Large; front crossed by a white bar below antennæ; fore coxæ and middle and hind tibiæ white at upper ends. . . . . *flavicaput*
Small; front normally even light gray; fore coxæ wholly white; mid tibiæ wholly gray, the hind ones with more white on distal portions. . . . . *scyton*
7. Abdomen with pink or yellow extending to base; at most with some of the dorsal loose hair whitish. 8
Abdomen pink but with the whole first segment gray, contrasting. *rosa*
Abdomen with several segments dark basally, at least on the dorsum; subterminally red, yellow, or at least suffused with cream subdorsally. 12
8. Color of abdomen pink. 9
Color of abdomen yellow; last segment black, contrasting; fore wing with discrete blackish spotting. . . . . *aoris*
9. Ground and pattern of confused shades of gray; antemedial and postmedial lines scalloped, white, defined with blackish. . . . *maia*
Ground pale, with discrete contrasting dark spotting, at least on basal portion of wing. 10
10. Fore wing with about 30 jet black spots, the ones about end of cell well separated. . . . . *atrigutta*
Spots of fore wing mainly gray, those about end of cell separated by the pale veins only. 11
11. Whole disc of hind wing translucent white, the borders only blackish; area of fore wing below the cell cream white, not or slightly darkened between the spots, which are slightly diffuse; M_3 and Cu_1 of hind wing strongly stalked. . . . . *Heliura balia*
Hind wing wholly or practically all, light gray; submedian area of fore wing shaded with light gray between the spots, making them appear slightly ocellate; M_3 and Cu_1 connate or barely stalked. . . . . *zamoræ*
12. Veins and antemedial, postmedial and at least half of medial lines dark, contrasting on a pale ground. 13
Veins and ordinary lines so far as traceable pale on a blackish ground, a large part of which they cut into quadrate spots. . . 15
13. Abdomen red, the middle without a continuous stripe; fore wing with ground luteous. . . . . *dentatum*
Abdomen gray and light yellow, the middorsum continuously gray; ground of fore wing practically white. 14

14. Outer margin concave; pattern with considerable shading of two shades of dark gray, with bars below M_1 and Cu_1 subterminally..... *striatum*
    Outer margin normal; fore wing lightly marked with gray on a white ground, none of the spots elongate..... *zephyrum*
15. Ground luteous, the spots relatively small, in the basal and marginal areas smaller than the spaces between them; dorsum with black middorsal dots on four penultimate segments..... *œolum*
    Ground darker, at least in the marginal area with the pale markings less extensive than the spots they define; three penultimate segments of abdomen without middorsal black spots.....16
16. Antemedial band formed of four or five sharp zigzags, separated by the pale veins, and preceded above A by an open blackish loop, the ground rather dark brown; submarginal spots similar, preceded by chevron-shaped black spots..... *pseudarchias*
    Antemedial band less regular, or pale, preceded by a solid black patch between fold and anal vein.....17
17. Subterminal spots all alike, black bars surrounded by pale loops, and preceded by chevrons which are reduced in cells M_2 and M_3; ground wood brown; antemedial area dominantly light, with confused fragments of a blackish antemedial line. .... *latifascia*
    Subterminal spots in cells M_3 and Cu_1 reduced, in a pale patch, the rest preceded by simple pale lines, not chevron-like; all lines narrow, simple and pale, cutting the ground into oblong patches. *hyalinum*

1075 Eucereon obscurum Möschler

Aclytia obscura Msch. Stett. Ent. Zeit. xxxiii, 348, 1872.
Epanycles stellifera Butler, Ill. Lep. Het. Br. Mus. i, 16: 10; 1877.
Also *figured:* Seitz 24: g3.

The blue body and pure white scaling on a coal black ground make an unique combination.

Flight scattering, late Oct.-Jan. (see diagram, p. 101). Lancetilla, Honduras. Mar.-May (Bts.). Mexico to Amazons.

1079 Eucereon rosa Walker

Euchromia (Eucereeon) rosa Wlk. List Lep. Ins. Br. Mus. i, 271, 1854.
Figured: Hamps. 16: 17; Seitz 24: h5.

This is the species as determined in the U. S. National Museum — the one with a white postmedial patch ending abruptly at M_2. In

E. rosadora Dyar the pale postmedian band is narrow, and even in width to Cu_2. Hampson's figure looks like *rosadora;* Seitz's is unrecognizable.

Oct., Dec., Jan., Apr., July-Aug. Honduras (type). Brazil.

1121e Eucereon zephyrum Schaus

E. zephyrum Schs. Ann. Mag. Nat. Hist. (8) vi, 194, 1910.
Figured: Hamps. Suppl. 19: 25; Seitz 25: h6 (*z. songoense*).

Distinguished by its paleness; dominant white ground, light markings, light gray body marked with yellowish white.

Feb. 17, 18, Mar. 3 (A.M.N.H.). Costa Rica (type) and Bolivia (*z. songoense* Ddt.).

1110 Eucereon striatum Druce

Theages striata Dr. Ann. Mag. Nat. Hist. (6) iv, 86, 1889.
Figured: Biol. 73: 9; Seitz 25: e2.

Easily recognized by its concave outer margin and remarkable resemblance to a caddis fly. Abdomen divided by a fine black dorsal line.

Mar. 9 (A.M.N.H.). Ranges north to Mexico and south to Brazil (*s. palleseens* Roth).

1085b (1085) Eucereon zamorae Dognin

E. zamoræ Dgn. Ann. Soc. Ent. Belge xxxviii, 681, 1894.
Figured: Hamps. Suppl. 18: 10; Seitz 30: g2 (unrecognizable).

The spots about the end of cell and from there to anal angle are exaggerated — also the subterminal spots above M_2 — making distinct dark patches. In one of the two specimens the basal spots are reduced in size, the orbicular is small and distant from the other spots, and the basal spots in fold and at inner margin are black, giving the appearance of *E. argutum* as determined in the National Museum. The latter in its original description is compared with *hogei*, a paler species with more complex markings.

Heliura balia is dot for dot the same, most definitely distinguished by the longer stalking of M_3 and Cu_1.

May 1 (normal) Feb. 27 (trans. to *argutum*) (Fried.). So. Mexico to Ecuador.

1088a Eucereon atrigutta Druce

E. atrigutta Dr. Ann. Mag. Nat. Hist. (7) xv, 464, 1905.
Figured: Hamps. Suppl. 18: 14; Seitz 24: 14.

In this species only the spots at base of inner margin and the basal one in cell Cu_2 are a little enlarged; in *E. quadricolor,* also reported from Panama, many spots are large and some partly fused.

Mar. 7, 22 (Fried.) Apr. 2 (Bradley, Cornell). Mexico to Venezuela; Sta. Catherina, Brazil.

1091a Eucereon hyalinum Kaye

E. hyalinum Kaye, Trans. Ent. Soc. London 1901, 119, 5: 11.
Also *figured:* Seitz 24: k4.

Besides the spot on the outer margin there is a conspicuous squarish yellow spot in the cell, and the scutellum is yellow. Abdomen above with red confined to subdorsal spots on 4, 5, 6, and anterior 2/3 of 7; beneath with a pink stripe on thorax, including whole of fore coxæ.

Dec. 24 (Bates) June 30 (Fried.) Venezuela and Trinidad.

1097 Eucereon maia Druce

E. maia Dr. Biol. Centr.-Am. Lep. Het. i, 86, 9: 13, 1884.
Also *figured:* Seitz 25: b3.

The most Noctuid-like in pattern of the Euchromiidae at hand, the ordinary lines being regularly scalloped and white filled, and ordinary spots dark with slightly paler centers. The basal hair is partly white.

Mar. 19 (A.M.N.H.). Guatemala to Guiana.

1093 Eucereon pseudarchias Hampson

E. pseudarchias Hmps. Cat. Lep. Phal. i, 497, fig. 272, 1898.
Also *figured:* Seitz 25: a2 (var. *aurantiaca*).

This is the darkest species of the group and the lines are most zigzag. Abdominal segment 3 red subdorsally as well as 4; ventral stripe leaving base of fore coxæ black, but covering abdomen. In var. *aurantiaca* Draudt the abdominal markings are orange. An abnormally pale specimen might key to *aeolum,* but shows the usual large dark spots about lower angle of cell and at least three subterminal ones.

Feb. 7, Mar. 3. Lancetilla, Honduras, Apr. 28 (Bts.). Mexico, to So. Brazil.

1095 Eucereon latifascia Walker

Eucerea latifascia Wlk. List Lep. Ins. Br. Mus. vii, 1639, 1856.
Figured: Hamps. 16: 14; Seitz 25: a4.

Abdomen as in *pseudarchias*, but ground of fore wing much paler, with a distinct pale spot in cell, and scutellum with two yellow spots. Under side of fore wing with pale postmedial spots.

Dec. 24 (Bts.), Feb. 12, Mar. 12 (A.M.N.H.), June 20 (Fried.). Guatemala to Peru and Amazons; So. Brazil? (abnormal).

1093b Eucereon dentatum Schaus

E. dentata Schs. Proc. Zool. Soc. London, 1894, 229.
Figured: Hamps. Suppl. 18: 26; Seitz 24: k5.

Pink on body covering penultimate segment, extending more or less onto second segment, and almost covering 3 and 4. Easily recognized by the combination of dark dentate ordinary lines and separate submarginal spots.

Nov. 28-Apr. 28. Jalapa, Mexico (type) to Ecuador.

1094 Eucereon æolum Hampson

E. æolum Hmps. Cat. Lep. Phal. i, 498, 16: 16, 1898.
Also *figured:* Seitz 25: a3.

Spots more numerous than in the preceding 3 species; the cell with three pairs, or the two outer and lower fused into a bar; pink of abdomen extending well onto 2d segment, the under side cream, not pink. Outer edge of fore coxæ blackish; scutellum with 2 yellow spots; pink segments with dorsal black dots.

Jan. 23-May 6. Mexico to Venezuela.

1102 Eucereon flavicaput Hampson

E. flavicaput Hmps. Cat. Lep. Phal. i, 501, 1898.
Figured: Biol. 9: 9 (as *leucophæa*); Seitz 25: b5.

Cream white to light olive, checkered over with blackish; ordinary lines heavy at costa; subterminal of several heavy bars and blotches running out to outer margin above M_3. Reniform phi-shaped. Head

with 2 yellow posterior spots; M_3 and Cu_1 of hind wing connate, as usual.

In *E. decora* the subterminal crosses cell M_3 and the reniform is simple.

Dec., Feb., May, July-Aug. Lancetilla, Honduras, May (Bts.). Ranges north to Mexico.

1121 Eucereon aoris Möschler

E. aoris Msch. Verh. z.-b. Ges. Wien. xxvii, 647, 8: 16, 1878.[1]
Also *figured:* Seitz 25: g4.

Pattern of fore wing much as in *Heliura balia*, differing in the normal Eucereon venation, with M_2, M_3 and Cu_1 of hind wing nearly connate, more contrasting spots on fore wing and yellow, instead of pink body.

Mar. 27 (Friedman). Described from Surinam.

1126 (also in Suppl.) Eucereon scyton Cramer

Sphinx scyton Cr. Pap. Exot. ii, 5, 99: B, 1777.
Eucereon mizar Dr. Ann. Mag. Nat. Hist. (7) iii, 231, 1899.
Also *figured:* Seitz 25: i1, 31: a4.

The synonymy is after Hampson. Cramer's figure, if of this species at all, must be very bad, and Seitz's first figure is a bad copy of it. If the Cramer name is incorrect *mizar* Druce can be used.

The moth looks like a miniature of the preceding, but has M_2 and M_3 connate and Cu_1 distinctly separate.

Jan. 28 (Bates). Ranges to southern Brazil.

1127 Eucereon phæoproctum Hampson

E. phæoproctum Hmps. Cat. Lep. Phal. i, 512, 17: 16, 1898.
Also *figured:* Seitz 25: i2.

Larger than *E. intranotata*, the light pm. area lunate, narrow; head yellow dorsally.

Feb. 17 (A.M.N.H.). Ranges to Guatemala.

1127b Eucereon intranotata Dognin

E. intranotata Dognin, Ann. Soc. Ent. Belge xliv, 436, 1900.
E. venosa Schs. Ann. Mag. Nat. Hist. (8) vi, 195, 1910.
Figured: Hamps. Suppl. 20: 3 (as *intranotata*), 4 (as *venosa*); Seitz 31: c4 (as *intranotata*), 3 (as *venosa*).

[1] Printed not earlier than 1878, see footnote (1) on p. 625. The date is usually cited as 1877.

The very dark gray vein-streaks tend to fuse here and there but do not invade the oval white postmedial spot, which reaches from R-stem to M_3.

Nov. 23-Apr. 7., July-Aug. Costa Rica, Ecuador.

Dyar described a species as *Teucer atcucer* from the Zone. It is clay color with confused brown markings, and a brown spot above anal angle, and is strikingly similar to *Eucereon pometinum* Dr. (Biol. 73: 11, Seitz 26: i6). The type shows the structures of *Ctenucha*.

Correbia Herrich-Schäffer

This genus and the following are obvious mimics of Lycid beetles. The present genus has longer wings and harder scaling, but the venational differences tend to fade out or vary individually. Hampson separates the genera on the stalking of M_2 and M_3, but in fact they may be stalked in Correbidia as well as Correbia. In the specimens at hand R_2 is free (1 specimen) or barely stalked, M_2 and M_3 long-stalked, the discocellular arising from just beyond the origin of Cu_1; hind wing with M_2 usually barely stalked, sometimes slightly separate, in the M. C. Z. specimen of *C. obtusa* well stalked. In Correbidia M_2 and M_3 of fore wing are very shortly stalked if at all, and never on hind wing, but M_3 and Cu_1 are normally connate or barely stalked.

1. Femora dominantly yellow, tibiæ yellow toward base; fore wing with black confined to an apical spot, fading out below M_2. *affinis*

   Femora black, with a yellow patch or bar toward base, tibiæ largely or wholly black; fore wing with apical patch larger, and normally with a second median bar. 2

2. Fore wing with the transverse median fascia (or costal patch) overscaled with lead blue like the apical one. . . . . *undulata*

   Fore wing with blue confined to apical patch between veins, the median fascia solid black. . . . . *lycoides*

1136 Correbia lycoides Walker

Euchromia (*Pionia*) *lycoides* Wlk. List Lep. Ins. B.M. i, 256, 1854.

Figured: Butler Ill. Lep. Het. Br. Mus. i, 8: 10; H.-S. Aussereur. Schm. fig. 265 (*ceramboides* H. S.); Seitz 25: k4.

Wings very narrow, typically with the apical black reaching in two-thirds way to the median fascia, which is also broad. The Panama specimens have the apical black extending in only to the fork of M_2 and M_3, and the median fascia hardly wider than the orange stripe

beyond it, or absent. This matches the original figure of *ceramboides*, though Hampson uses this name in error for the darkest specimens.

Oct., Dec., Jan., Feb. Reported from Mexico to Brazil, but the distribution uncertain from confusion with related species.

1137 Correbia undulata Druce

Pionia undulata Dr. Biol. Centr. Am. Het. i, 77, 9: 3, 1884.
Also *figured:* Seitz 25: k5; (typical), l1 (var. *flavidorsalis*).
C.u. nigridorsalis and *flavidorsalis* Draudt, Seitz' Macrolep. World vi, 186, 1915.[1]

The wings are slightly broader than *C. lycoides*. In all the specimens at hand the abdomen is solid black dorsally (var. *nigridorsalis*); the typical form, from Guatemala, has a transverse yellow band, and in var. *flavidorsalis* about 4 middle segments are yellow, with black base and apex.

Feb. 12 (A.M.N.H.), Mar. 26 (Fried.). Lancetilla, Honduras, Mar.-May (Bts.). Ranges north to Mexico.

1140 Correbia affinis Druce

Pionia affinis Dr. Biol. Centr. Am. Het. i, 77, 9: 4, 1884.
Also *figured:* Seitz 26: b1.

The small apical spot varies in size, and presumably *C. raca* Dr. (Biol. 72: 18) is merely an extreme form which has lost it.

Flight scattering (see diagram, p. 101). Guatemala (type).

Correbidia Hampson

A slight variant of the preceding genus. I suspect all the following are forms of one species, and that the redder orange forms from the Antilles and more yellow ones from South America are mere subspecies. The former are *bicolor* H.S. (corresponding to *striata*), *apicalis* (with incomplete bands, between *germana* and *costinotata*) and *terminalis* Wlk. (corresponding to *germana*); the latter are *calopteridia* Btl., *assimilis* Roth, and *cimicoides* H.S. *C. euryptera* Dgn., with its light variety *joinvillea* Schs., seems to be a distinct species, with subfalcate apex, and M_2 and M_3 of fore wing constantly stalked.

1. Fore wing orange, with fuscous streaks between veins toward apex and black streak on inner margin only..... *striata*
   Fore wing with a heavy black apical patch..... *elegans*

[1] The date of this fascicle is given on it, and in the Zoölogical Record as 1915; it was not received in Ithaca till after the War.

Fore wing with a small median costal spot also. . . . . *costinotata*
Fore wing with a complete median black band. . . . . *germana*

[1145 Correbidia terminalis Walker

Pionia terminalis Wlk. List Lep. Ins. Br. Mus. vii, 1633, 1856.
C. terminalis Forbes, Sci. Surv. P. R. xii, (1), 27, 1930.
Figured: Hamps. fig. 274.
Larva: Gundlach, An. Soc. Esp. Hist. Nat. xx, 156, 1891.

Larva on under side of leaves of Cecropia.
Redder than Continental races — from Greater Antilles.]

1145.1, 1146, 1147, 1145c, 1146a Correbidia terminalis elegans Druce

Pionia elegans Dr. Biol. Centr. Am. Het. i, 78, 9: 6, 1884.
C. terminalis ssp. 1, Hamps. Cat. Lep. Phal. i, 519, 1898; *C. germana* Roth. Nov. Zool. xix, 182, 1912; *C. t. continentalis* Ddt., Seitz' Macrolep. World vi, 187.
Pionia striata Dr. Biol. Centr. Am. Het. i, 78, 9: 5, 1884.
C. costinotata Schs. Ann. Mag. Nat. Hist. (8) vii, 183, 1911.
Also *figured:* Hamps. Suppl. 21: 1 (*germana*), 5 (*costinotata*); Seitz: 26: b2 (*elegans*), a5 (*germana* as *continentalis*), a6 (*striata*); 31: f4 (*costinotata*).

The legs vary somewhat, but do not fall into color-groups like the species of Correbia; the tarsi are always solid black without the white of Correbia spp.

Common, banded forms commoner than plain (see diagram, p. 101). Ranges north to Mexico, and southward probably intergrades with the yellow forms, but the material is insufficient.

Hyaleucerea Butler

Perhaps the most primitive genus of the family, R_2 being free, and Sc sometimes preserved; the forms with Sc generally show parts of the Eucereon pattern, interrupted by transparent areas.

1. Fore wing solid blackish; hind wing with Sc strong, male with acute lobe and pencil. . . . . *luctuosa*
Fore wing with disc and basal part toward inner margin whitish with contrasting dark veins; Sc lost; male without secondary sexual characters. . . . . *fusiformis*

1181 Hyaleucerea luctuosa Möschler

Heliura luctuosa Msch. Verh. z.-b. Ges. Wien xxvii, 642, 8: 13, 1877.

Body metallic green, wings and dorsal hair blackish. No markings, approaching Episcepsis.

July 20 (Friedman.) Surinam (type); Colombia.

1183 Hyaleucerea fusiformis Walker

Pampa fusiformis Wlk. List. Lep. Ins. Br. Mus. vii, 1629, 1856.
Figured: Hamps. fig. 284; Seitz 26: b4.

Three pairs of scarlet dots on head and thorax; under side spotted with white.

June 25 (Fried.) Oct. 31 (Bts.). Ranges to the Amazons.

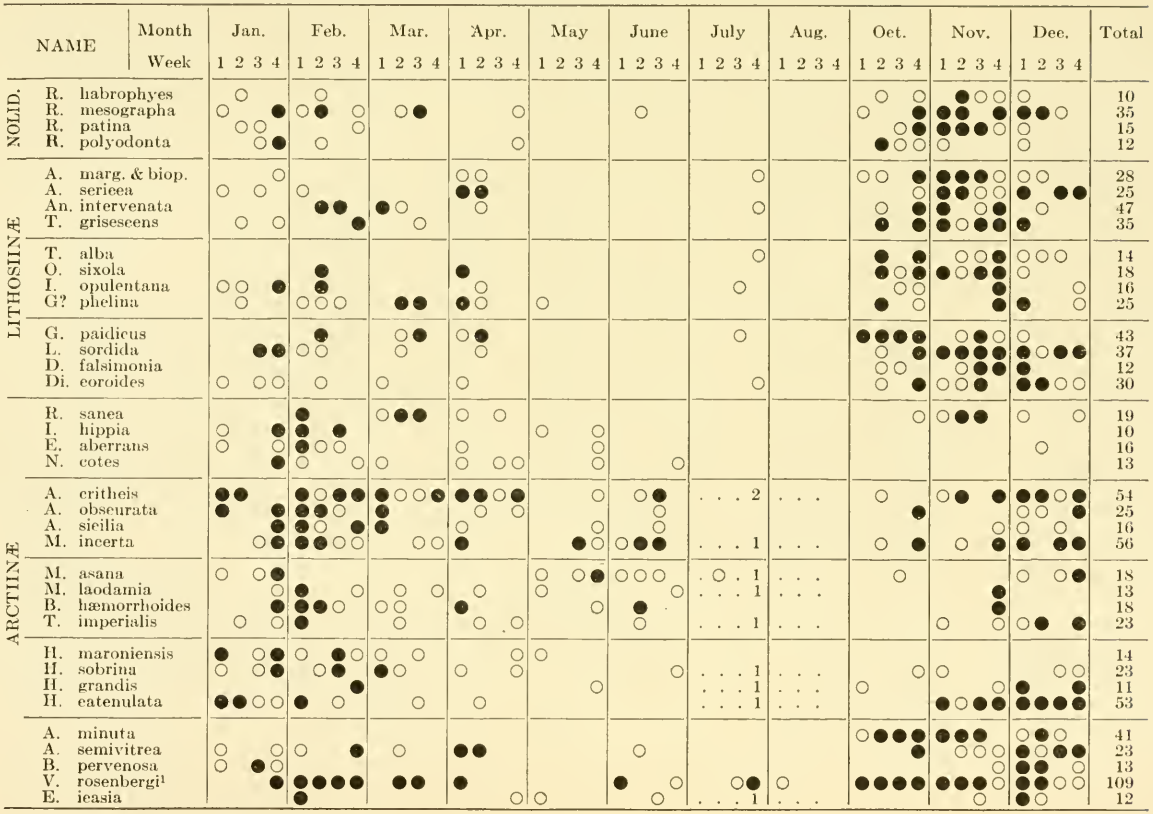
NOLIDÆ

Head with beak-like palpi, moderate tongue, and no ocelli. Thorax with tympanum (Richards, Ent. Am. xiii, 33, fig. 151) of Erastriine type, the hood very small and above spiracle, fore wing with 4-branched Cu, hind wing frequently 3-branched by fusion of M_3 and Cu_1; scaling soft, the fore wing with raised tufts (usually 3); Sc of hind wing moderately fused with cell. Larva distinctive, only one subdorsal wart on each abdominal segment, and first pair of prolegs lost; living in a folded leaf as a rule. Pupa in a cocoon with a vertical slit-like valve (as in the Sarrothripinæ).

A distinct and very homogeneous little family, treated by Dyar among the "micros", by Hampson as a mere subfamily of Arctiidæ. The condition of tympanum and the cocoon show a distinct connection with the intermediate Noctuidæ, so the likeness to the Lithosiinæ must be parallelism.

All the Central American species are closely related and might well be left in a single genus (Nola) but are here allowed to stand in the three genera recognized by Hampson. The final fork of R_3 and R_4, or R_2 and R_{3+4} has generally been overlooked, so several species have had to be transferred to a different genus, unless we abandon separation. There are more striking differences in the modification of the male radial system that were mostly overlooked by Hampson. I believe the species that have them are all Rœselias, forming the subgenus Nolidia, though the one or two studied by Hampson were put by him in Nola.

The Rœselias have their principal flight in November; the three Nolas were all taken in October.



[1] Six spec. coll. by Fairchild July-Aug. also.

1. Fore wing with all radials preserved, R_3 sometimes very short, and leaving R_4 just before margin..... *Rœselia*
   Fore wing with R_3 and R_4 united, R_2 separate, but sometimes very short and leaving R_{3+4} just before margin, typically distinct. *Nola*
   Fore wing with R_2, R_3 and R_4 united (none yet found from the Canal Zone that definitely belong here)..... *Celama*

Direct Key to Species

1. Fore wing with outer half contrasting blackish, containing the two outer scale-tufts, which are lead gray..... *habrophyes*
   Outer half of fore wing concolorous, or with narrow dark border only.....2
2. The two outer cell-tufts close together, lead gray, and contained in a common dark brown patch, which may extend narrowly to inner margin..... *mesographa*
   The three cell-tufts normally evenly spaced,— if the two outer are contained in a common brown patch this patch extends to base.....3
3. Fore wing pure white to subterminal line, the postmedial line obsolete..... *pernitens*
   Postmedial line distinct, the ground rarely pure white.....4
4. Median and postmedial lines both distinct, separate, fine and dark toward inner margin.....5
   Median and postmedial lines not both distinct toward inner margin, if both present diffuse and partly fused.....7
5. Median line deeply scalloped, the postmedial double and evenly sinuate..... *polyodonta*
   Median line even or moderately scalloped; postmedial single....6
6. Expanse under 12 mm., median line nearly straight below cell, in contrast with the strongly sinuous postmedian..... *prothyma*
   Expanse over 12 mm.; median and postmedial line parallel or nearly so, the medial normally excurved and waved.... *melletes*
7. Larger species, R_2 deeply cleft from R_{3+4}, which fork, tho' sometimes only at extreme margin.....8
   Smaller species; R_2 at most a minute fork on R_{3+4}, which are united.....10
8. Larger, white and cold gray; the tufts iridescent with lemon yellow in a favorable light, the outer one marked by a triangular dark gray spot on costa.....9
   Smaller, ground luteous, and markings more diffuse and decidedly

brownish, the spot before the second tuft squarish, and no lemon yellow tint..... *æschyntela*

9. Only the outer tuft accompanied with a triangular spot on costa, collar with subbasal and subterminal blackish bars, in one specimen fused into a large black spot, leaving only the tips whitish; tufts decidedly yellow..... *patina*

Both tufts accompanied by less intense gray triangles, so that the whole costa from base to 2/3 is darkened; collar suffused with gray..... *recedens*

10. Costa with a broad pale portion separating the bar at second tuft from the triangle at the third tuft; outer and inner margins gray and white, without any brown tint..... *sylpha*

Costa well infuscated to beyond middle, only interrupted by a narrow whitish bar beyond first tuft; outer and inner margins and scutellum strongly shaded with luteous..... *n. sp.*

Rœselia Hübner

In all the New World species the male antennæ are pectinate to about 2/3. M_3 and Cu_1 of hind wing may be stalked or united; the fore wing may have the accessory cell normal, minute (usually, at least in ♀) or absent. Some males have a fovea in outer part of cell, and another between R_1 and R_2, distorting the venation. The apical fork of R_3 and R_4 is often extremely short and has been overlooked, causing the species to be put in Nola.

Group I: Tufts of fore wing shining lead gray, the second tuft nearer the outer than the inner, and accompanied by a smaller tuft nearer costa; male with foveæ in cell and below R_1, distorting the venation, which has the R-stem and M_1 at base swollen, close together and distorted; accessory cell absent in male, minute, triangular and resting on apex of discal cell in female; terminal free part of R_3 minute.

Rœselia habrophyes Dyar

Nola habrophyes Dyar, Proc. U. S. Nat. Mus. xlvii, 248, 1914.
Figured: Seitz 66: b1.

This differs from the other similarly marked neotropical Nolidæ by the second tuft being included in the black border. There are many raised scattered lead scales, besides the regular tufts. Hind wing with M_3 and Cu_1 united.

Oct. 11 to Jan. 13 (see diagram). Trinidad River (Busck).

66a Rœselia mesographia Schaus

Nola mesographa Schs. Proc. U. S. Nat. Mus. xxix, 195, 1905.
Figured: Hamps. Suppl. 23: 30; Seitz 32: a2.

The median black area varies in development, but is most typically a black bar across the wing. M_3 and Cu_1 of hind wing stalked.

Nov.-Feb. (see diagram). Ranges to Southern Brazil.

Group II. Tufts of fore wing largely white, more or less mixed with light gray and brown, equally spaced, or in *R. œschyntela* the middle one a little nearer the basal; frequently with light lemon yellow iridescence; no extra tuft between second one and costa; foveæ rarely so much developed as to make R and M_1 approximate (*patina*); accessory cell usually present in both sexes and large in female.

140 Rœselia patina Druce

Nola patina Dr. Biol. Centr. Am. Het. i, 140, 13: 19, 1885.
Also *figured:* Seitz 32: e6 (enlarged).

Middle tufts nearer basal than apical; foveæ as in preceding group, Rs turning down sharply from the nearly straight R_1 and much thickened; female with M_1 also close to Rs. No accessory cell. Hind wing with M_3 and Cu_1 stalked.

Markings light and rather clear (much whiter than the Seitz figure); antemedial line excurved below tuft, postmedial single, sinuate but not dentate.

Dominant in Nov. (see diagram). Costa Rica.

Rœselia æschyntela Dyar

Nola œschyntela Dyar, Proc. U. S. Nat. Mus. xlvii, 246, 1914.
Figured: Seitz 67: e4.

Foveæ as in Group I (♀ not seen) M_1 not closely approximate; second tuft central; fork of R_2 strong; M_3 and Cu_1 of hind wing united. Markings blurred, the combined median and postmedia toward inner margin making a thick bar.

Oct. 27, Nov. 3, 29 (Bts.) all ♂. Described from the Canal Zone.

Rœselia melletes Dyar

R. melletes Dyar, Proc. U. S. Nat. Mus. xlvii, 245, 1914.
Figured: Seitz 66: d6.

Foveæ slight but distinct, the base of R_1 sharply curved to make room for the fovea below it; the main R-stem nearly straight, and with a lance-like accessory cell at end of discal cell. Tufts stocky, the second rather nearer the third; hind wing with M_3 and Cu_1 united.

Subterminal line deeply dentate, and broken, formed of 3 oblique blackish dashes, more sharply defined than in *R. limona* Schs. from Costa Rica.

Lancetilla, Honduras, (Bates). Described from Canal Zone.

Rœselia prothyma Dyar

Nola prothyma Dyar, Proc. U. S. Nat. Mus. xlvii, 247, 1914.
Figured: Seitz 66: c1.

Easily recognized by the minute size and fine clean lines. *Nola joanna* Schaus is very close, but has a different antemedial line, and darker costal edge and fringe.

Oct. 12 (Bates). Described from the Canal Zone.

107a Rœselia polyodonta Schaus

R. polyodonta Schs. Proc. U. S. Nat. Mus. xxix, 195, 1905.
Figured: Hamps. Suppl. 24: 20; Seitz 32: c7.

The triple median-postmedial lines on a white ground separate this species from any other in Panama; the male has a brown shade on basal half of costa. *R. bifiliferata* Walker is very close, but the antemedial line is more oblique and more distinctly double.

Male with R_3 minute or absent (only one male at hand from Barro Colorado); R_1 and M_1 widely separated; no distinct fovea; accessory cell absent (minute but present in the specimens of *R. bifiliferata* at hand); hind wing with M_3 and Cu_1 united. Female much larger, with R_3 and accessory cell well developed.

Principal flight in October, the only male in Jan. (see diagram), Mar. (Bradley, Cornell). Lancetilla, Honduras, Apr. (Bts.). Mexico to Guiana, replaced by *R. bifiliferata* further south.

106b Rœselia pernitens Schaus

R. pernitens Schs. Ann. Mag. Nat. Hist. (8) vii, 355, 1911.
Figured: Hamps. Suppl. p. 423, fig. 59.

Second tuft much reduced, pure white, the others blackish; fovea in cell distinct but short, but with no trace of the one below R_1; R_1 and Rs

being normal, gradually divergent. M_1 distant; acc. cell trapezoidal, based on costal side of discal cell; hind wing with M_3 and Cu_1 united.

Nov. 2, 16, 25 (Bts.) ♀ only, Apr. (Bradley, Cornell) 1 ♂; Hamburg Farm, Costa Rica (Dodge). Described from Costa Rica.

Nola Leach

Identical with the preceding genus, except for the complete loss of R_3. The costal venation is rarely if ever modified, and accessory cell lacking as a rule.

Nola recedens Schaus

N. recedens Sch. Proc. U. S. Nat. Mus. lix, 354, 1921.
Figured: Seitz 56: c4.

A clear Nola, with R_2 and R_4 deeply forked, but no sign of R_3; accessory cell present, small, but bearing R_1 (♀), M_1 widely separate. Superficially very close to *R. patina*.

Nov. 29 (Bates) 1 ♀. Described from Guatemala.

Nola sylpha Dyar

Celama sylpha Dyar, Proc. U. S. Nat. Mus. xlvii, 248, 1914.
Figured: Seitz 66: d2.

This little species is rather common in some places in northern South America; it is marked superficially by appearing to have large yellow-gray blotches representing the orb. and ren. Postmedial more evenly oblique than in the preceding.

No fovea or acc. cell, hind wing with M_3 and Cu_1 united.

Oct. 27, 30 (Bts.). Described from the Canal Zone. Also Guiana and Amazons (Cornell).

There is a single broken female of another species of the same group of Nola. Dyar has described numerous further species from the Canal Zone in Proc. U. S. Nat. Mus. xlvii, 245–248, 1914.

ARCTIIDÆ

Head variable. Thorax as in the Euchromiidæ, the tympanic hood normally similar, but frequently reduced; never well developed and surrounding the spiracle. Venation of fore wing as in Euchromiidae, but hind wing with Sc normally preserved, in the Phegopterinæ as a

rule not reaching the margin, and rarely absent; R sometimes also completely fused with M_1, M_2 normally quadrifid, sometimes stalked or united with M_3, but never obsolescent from angle of discocellular. Metascutellum commonly less prominent than in the Euchromiidæ. Larva as in the Euchromiidæ, but usually with two separate subdorsal warts each on meso- and metathorax, frequently with hair reduced, but at least with two setæ on wart iii of abdomen; pencils usual in the Phegopterinæ, but not showing the massive lateral pair on first abdominal segment, which is so common in the Euchromiidæ. Pupa various.

In the normal groups, here treated as Arctiidæ, Sc and R of the hind wing are separate at the extreme base, or rarely fused, and much swollen, then fused for half, more or less, of the length of the cell, but separate before its end, with few exceptions; in the Pericopidæ and Hypsidæ the fusion is slight or none, but many workers would now add these groups to the Arctiidæ, since the tympanum and early stages are the same.

The two subfamilies are sometimes treated as separate families, the general line of evolution being quite different, but in technical characters the only final difference is the loss of the ocellus in the Lithosiinæ; — in fact *Lerina*, which is a member of the Phegopterine Arctiinæ in every other way, has lost the ocellus, while a rudiment is preserved in Hypoprepia, which is otherwise a normal Lithosiid. Both subfamilies are world-wide, but the Lithosiinæ are weak in the nearctic. Of the subgroups, the Phegopterini are strictly new-world, unless Rhodogastria belongs to them, as the tympanum and hind wing would suggest, though the larva resembles Utetheisa; the Arctiini are overwhelmingly North Temperate, but with scattered types in the tropics; the Utetheisini are Old-world, save for the single genus Utetheisa, which must be a recent comer in the New. The classification of the Lithosiinæ is too uncertain to make discussion of value, but the typical Lithosia group is certainly found in both hemispheres (Agylla), and the Hypoprepia group is strictly New-world (Diarhabdosia). The genera are practically all distinct in the two hemispheres.

Subfamily LITHOSIINÆ

Ocellus absent. Weak forms, frequently with long palpi and reduced venation. Scaling generally soft; tympanum frequently with hood reduced or lost; tongue generally strong. Larva with the subdorsal warts on meso- and metathorax when distinct, obliquely or longitudi-

nally placed; the hair usually more or less reduced; food almost always mosses or lichens. Pupa not studied.

A group very characteristic of humid areas, sluggish in flight and usually occurring in small colonies. Some of the species have very small areas of distribution, but more generally colonies repeat over a wide area in suitable environments. Many more species will certainly be found on Barro Colorado Id.

Key to Genera

1. Fore wing with R_5 free, there being two free veins between the forked apical one and the end of the cell. . . . . *Metallosia*
   Fore wing with R_5 stalked with R_{3+4}, or with one or two radial veins lost 2
2. Hind wing with a dorsal vein absent. 3
   Hind wing with all veins present or R and M_1 united 16
3. Fore wing with accessory cell. . . . . *Apistosia*
   Fore wing with R_{3-5} simply stalked or united. 4
4. Fore wing with M_2 and M_3 stalked and hind wing with R and M_1 united. . . . . *Lycomorphodes*
   Fore wing with M_2 and M_3 normally separate, occasionally connate or short-stalked when R and M_1 of hind wing are stalked. 5
5. Fore wing with a radial vein lost; R_3 and R_5 stalked; hind with R and M_1, M_2 and Cu_1 stalked. . . . . *Serincia*
   Fore wing with all veins 6
6. R_4 and R_5 united beyond the origin of R_3 7
   R_3 and R_4 united beyond the origin of R_5 12
7. Hind wing with only two veins from lower angle of cell, and none from middle of end of cell (M_2 and Cu_1 united) 8
   Hind wing with 3 dorsal veins 10
8. Fore wing with Sc and R_1 anastomosing, M_1 free . . . . . *Odozana*
   Fore wing with Sc and R_1 free 9
9. M_1 stalked on R-stem. . . . . *Phaulosia* (*Saozana*)
   M_1 free. . . . . *Geridixis*
10. Palpi minute, not reaching front; hind wing with R and M_1 stalked. . . . . *Diarhabdosia*
    Palpi moderate, extending well beyond base of front. 11
11. Fore wing with R_1 free, hind wing with R and M_1 stalked. *Palæozana*[1]

[1] Mulona would run here, but has R and M_1 of hind wing free. The supposed Mulona of the mainland (*phelina*) has M_2 distinctly preserved in the hind wing, though a little weak, and is certainly not related. It will lie rather between Nodozana and Gaudeator. The Mulona group appears to be limited in the New World to the West Indies.

Fore wing with R_1 running into Sc; hind wing with R and M_1 stalked.....*Paraprepia*

12. Hind wing with R and M_1 united.....15
Hind wing with R and M_1 stalked.....13
Hind wing with R and M_1 separate.....*Gardinia*

13. Fore wing with M_2 and M_3 separate.....14
Fore wing with M_2 and M_3 connate, hind wing with R and M_1 short-stalked.....*Ardonea*

14. Costa of fore wing arched, Sc and R_1 anastomosing....*Barsinella*
Costa of fore wing straight, the wing narrower; Sc and R_1 free. *Callisthenia*

15. Fore wing normal in form.....*Talara*
Fore wing with outer margin oblique and concave at middle. *Dolichesia*

16. Accessory cell present.....*Agylla*
No accessory cell, R_{3-5} stalked or partly united.....17

17. Fore wing with R_2 stalked beyond origin of R_5.....18
Fore wing with R_2 from cell.....19

18. Fore wing with M_3 and Cu_1 separate.....*Anœne*
Fore wing with M_3 and Cu_1 stalked.....*Dixanœne*

19. Fore wing with R_5 stalked beyond origin of R_3, or one or two radials lost.....20
Fore wing with R_3 stalked beyond the origin of R_5.....24

20. Hind tibiæ with end spurs only preserved; front very narrow below between eyes, and palpi and tongue minute.....*Thyone*
Hind tibiæ with both pairs of spurs; tongue and palpi normal. 21

21. Hind wing with M_3 and Cu_1 distinctly separated; palpi upturned; markings generally complex.....22
Hind wing with M_3 and Cu_1 connate or shortly stalked; palpi more porrect.....23

22. Fore wing with one radial lost, only one rising separately from cell.....*Afrida*
Fore wing with all radials present, two rising separately from cell. *Clemensia*

23. Fore wing with M_2 nearly straight and arising nearly equi-distant between M_1 and M_3.....*Gaudeator*[1]
Fore wing with M_2 arising close to M_3, and curved up..*Nodozana*

24. Hind wing with M_3 and Cu_1 stalked (united in some species not yet taken in the Canal Zone).....*Prepiella*

[1] "*Mulona*" *phelina* will run here; it is distinguished by the straighter costa and entirely different pattern.

Hind wing with Cu_1 and Cu_2 stalked ..... *Gardinia*
Hind wing with M_3 and Cu_1 arising close together but separate, M_3 sometimes stalked with M_2 25

25. Fore wing with R_1 anastomosing or running into Sc, the venation otherwise normal. Antenna with shaft smooth; hind tibia with four spurs; R not stalked in hind wing ..... *Antona*
R_1 free from Sc; otherwise as before (occasionally Hypareva may have Sc and R_1 anastomosing and will run to Balbura, but is an entirely different looking form, mainly white) 26

26. Fore wing with M_2 and M_3 stalked; markedly in female, sometimes merely connate in male, which has fore wing with disarranged sex-scaling; palpi short ..... *Hypareva*
Fore wing with M_2 and M_3 from cell; Cu_2 normal, palpi moderate, upturned 27

27. Hind wing with M_3 and Cu_1 distinctly separate ..... *Illice*
Hind wing with M_3 and Cu_1 connate, from the extended lower angle of the cell ..... some specimens of *Prepiella aurea*

Hypareva Hampson

This genus, with Agylla and Apistosia, belongs to the typical Lithosia group, marked by a tendency to narrow the wings, generally pale colors, very frequently with a dark stripe on the thorax and inner margin, and frequently some dorsal veins of the fore wing lost (none in the present genera). Most of the few known larvæ have large warts, with numerous sparse weak hairs, and brilliantly patterned skins; on the thorax the two upper warts are almost longitudinally placed, unlike the Arctiinæ.

Venation curiously unstable; Sc and R_1 normally approximate, occasionally running together, R_3 and R_4 stalked the farthest (one exception at hand), M_2 and M_3 stalked for a very variable distance (occasionally connate), hind wing with M_2 and M_3 long stalked, or rarely united. In the single known species the male has much more triangular wings, overlaid with pearl gray sex-scaling, which soon fades to a dirty clay color, a shaggy tuft on under side of fore wing, gland on hind wing, fringe on fore femur, etc.

291 Hypareva pogonoda Hampson

H. pogonoda Hmps. Cat. Lep. Phal. ii, 192, fig. 112.
Also *figured:* Seitz 37: 13 ♂.

The female is narrow-winged; plain white, or a little infuscated along inner margin.

Oct. 1 (Bts.). Lancetilla, Honduras (Bts.). Ranges from Mexico to Surinam, where it is abundant.

Agylla Walker (*Areva* auct., *Crambomorpha* Walker)

This genus is presumably ancestral to the whole Lithosia group, having preserved a complete venation and the accessory cell. Many species have sex tufting or glands, on wings, body or legs, and a few have narrowly pectinate antennæ. Further species should be discovered on the Island.

1. Front black, contrasting; fore wing with inner margin at most gray at middle; male antennæ narrowly pectinate.....2
   Front paler than vertex, except in A. separata which has the inner margin gray; male antenna ciliate 4
2. Expanse about 30 mm.; vertex black, collar and occiput yellow; antennæ broader.....*zucarina*
   Expanse about 40 mm.; vertex as well as occiput light, collar white or light gray; antennæ narrower 3
3. Vertex cream; costal edge of fore wing narrowly yellow in male. *niphostibes*
   Vertex yellow; costal edge broadly yellow in male, narrowly in female.....*nivea*
4. Fore wing with inner margin contrasting gray below the fold....5
   Inner margin very slightly darkened or not at all; male abdomen covered with shaggy buff hair.....*sericea*
5. Male abdomen with massive black anal tuft; dorsal stripe broad..6
   Male abdomen with lengthened yellow valves, ground tinted with yellowish; female with naked middorsal spot on penultimate segment; fore wing of both with narrow gray dorsal stripe. *separata*
6. Under side of male fore wing dominantly fuscous, the region beyond lower angle of cell fuscous; also apex of hind wing. *marginata*
   Under side of male fore wing light yellowish, blackish only along inner margin; no fuscous on hind wing.....*bioptera*

399 Agylla zucarina Dognin

Macrocrambus zucarina Dgn. Ann. Soc. Ent. Belge xxxviii, 123, 1894.
Figured: Dognin, Lep. Loja 11: 8; Seitz 37: b6.

Easily distinguished by the black head. The male antennæ are broader than in the related species.

Mar. 9 (A.M.N.H.) 1 bad ♀. Chiriqui to Peru.

400.1a Agylla nivea virginea Schaus

(*Lithosia nivea* Wlk. List Lep. Ins. Br. Mus. vii, 1778, 1856.)
(*Figured:* Hamps. fig. 115; Seitz 37: c1 (typical); Dognin, Lep. Loja 11: 6, 6a (ab. *plateada* Dgn.), 5 (ab. *florecilla* Dgn.))
Crambomorpha argentea Fld. Reise Novara Lep. 106: 10, 1874.
Crambomorpha virginea Schs. Proc. Zoöl. Soc. 1894, 240.
Not *Salapola argentea* Wlk. List Lep. Ins. Br. Mus. xxviii, 525, 1863, which is also an Agylla (Hamps. p. 200).

In *A.n. virginea* the head is yellow and front of thorax fuscous, in the type form they are white.

Mar. 9 (A.M.N.H.) one female appears to belong to this species, which ranges from Mexico to southern Brazil.

429 Agylla separata Schaus

Choria separata Schs. Proc. Zoöl. Soc. 1894, 240.
Figured: Hamps. fig. 126; Seitz 37: i2.

The dark face would put this species in the argentea group, but the antennæ are simple.

Mar. 9 (A.M.N.H.). Chiriqui to southern Brazil.

418 Agylla marginata Druce

Areva marginata Dr. Biol. Centr. Am. Het. i, 133, 1885.
Figured: Hamps. 24: 8 ♂.

Upper side of head and body as well as inner margin of fore wings light gray. Our specimens are smaller than typical *marginata* (20-23 mm.), and may be merely a dark variant of the following. In any case I can see no difference in the ♀. The darkest male happens to be the smallest.

Male dates Oct. 10-Nov. 13. Diagram (p. 163) of this species and the following combined on account of the impossibility of separating females. Typical *marginata* is reported from Mexico to Costa Rica.

Agylla bioptera Dyar

A. bioptera Dyar, Proc. U. S. Nat. Mus. xlvii, 164, 1914.
Figured: Seitz 66: 18.

Differs only in the paler male under side.

Male dates Oct. 28-Jan. 27. Described from the Canal Zone.

Dyar describes *A. niphostibes* from the Canal Zone (Seitz 66: 110). It is large and pure white. *A. argentifera* Wlk. also covers the Zone in its range. It is very close to *niphostibes,* but the male has an oblique gray splash near inner margin.

423 Agylla sericea Druce

Crambomorpha sericea Dr. Biol. Centr. Am. Het. i, 132, 1885.
Figured: Maassens Reise Sud.-Am. Lep. 4: 27 (as *Mieza galactina*); Seitz 37: f4 ♀.

Nov.-Apr. Lancetilla, Honduras (Bts.). Mexico to Peru, the closely related species or subspecies *petrola* in Brazil.

Dyar reports *Aptilosia crocea* from the Canal Zone on the basis of a couple of females only. I have examined them and believe they are females of this species with a little more gray shading than usual on the inner margin. The male will be needed for certainty. In the true Aptilosia the male is yellow, with venation of Hypareva, but no sex-scaling on fore wing, and both sexes have the gray on inner margin broad.

Ardonea morio Wlk. has been taken at the R. Indio de Chagres. It is immaculate deep blue (Seitz 36: d6).

Apistosia Hübner

Differs from Agylla only in the union of M_2 and M_3 of the hind wing. Most species resemble Agylla, but the following (the genotype) differs in color.

467 Apistosia judas Hübner

Hipocrita judas Hübner, Erste Zutr. (1808 as n. nud., validated by publication of plate 1808–1814, changed to *Apistosia* in definitive text 1818), Zutr. Exot. Schm. i, 13, 9: 51–52.
Also *figured:* Hamps. fig. 146; Seitz 36: e3.

Bronze green with pale fringe; head and dorsum of thorax orange. Male antennæ pectinate.

Apr. 28-May. Guatemala to Tucuman, Argentina.

Dyar reports *Gardinia magnifica* Walker (Seitz 65: i3) from the Canal Zone. It stands in present arrangements by itself, but the tympanum and all female characters are normal Lithosiid. In the male

the hind wing has the cell much shortened in front, with R, M_1 and M_2 approximate from the tip of the R-stem, Cu wholly independent, and forked, M_3 lost. It is unicolorous green-black.

He also reports *Achroosia nuda* Hamps. (Seitz 26: a3); it is pure white, with broader wings than *Thyone alba*. The present collection contains a specimen from Lancetilla, Tela, Honduras. It was described from Brazil.

Antona Walker (with *Balbura* Walker)

All the species of this genus but the genotype, have striking black streaks between (not on) the veins, and the one in the end of the cell and that above M_2 are often continuous. Antona is supposed to have M_2 and M_3 of hind wing separate and Balbura stalked; but in fact "*Antona*" *diffinis* and "*Balbura*" *intervenata* are merely subspecies, both having the pattern of Balbura and the separate M_2 and M_3 of Antona.

1. Collar orange, concolorous with rest of thorax ..... *dorsisigna*
   Collar black, like head, contrasting with rest of thorax. *intervenata*

719 Antona dorsisigna Walker

Balbura dorsisigna Wlk. List Lep. Ins. Br. Mus. ii, 481, 1854.
Figured: Hamps. fig. 245; Seitz 32: i5.

Male with anal angle slightly lobed, M_2 and M_3 stalked. Fore wing with an orange basal spot (not shown in the Seitz figure).

Nov. 11, Dec. 14, (Bts.), Apr. 6 (Fried.), July-Aug. (Fair.). Honduras to Guiana.

719b Antona intervenata Schaus

Balbura intervenata Schs. Ann. Mag. Nat. Hist. (8) vii, 362, 1911.
Figured: Hamps. Suppl. 34: 6; Seitz 35: a2.

A mere subspecies of *A. diffinis* Walker, which has the disc of the thorax darker (chestnut, not black as stated) and comes from Guiana.

Oct. 26-Apr. (see diagram, p. 163). Described from Costa Rica.

Thyone Walker

A delicate little genus, typically with enormous eyes, almost meeting below. The genus appears isolated, but may have some connection with Lithosia. The white species differ in the male antennæ but deter-

minations are in confusion. The following species is certainly *alba* Dr. and may be the true *simplex* Wlk., but is certainly not the species that goes for *simplex* (*parvita* Schs.). Even examination of the types will not clear up the case as they are mostly females.[1]

1. Gray; antennæ blue-black, simple..... *grisescens*
   White; antennæ white on basal half, subpectinate..... *alba*

731b Thyone grisescens Schaus

T. grisescens Schs. Ann. Mag. Nat. Hist. (8) vii, 362, 1911.
Figured: Hamps. Suppl. 34: 6; Seitz 35: a2.

Immaculate, the legs a little and antennæ much darker.
Oct.-Jan. (Bts.) (see diagram, p. 163). Costa Rica (type).

734 (in part) Thyone alba Druce

Lithosia alba Dr. Biol. Centr. Am. Het. i, 131, 1885.
? *Thyone simplex* Wlk. List Lep. Ins. Br. Mus. ii, 553, 1854.
(Not *Thyone simplex* of Hamps. fig. 255, which appears to be *T. parvita* Schaus.)

White, even the front white; fore legs and base of costal edge gray; tips of antennæ usually more or less gray.

Oct. 12-Dec. 21 (Bts.). Mar. 29-Apr. 4 (Bradley, Cornell) see diagram. Outside distribution uncertain through confusion with other species, all the South American material at hand being other species. *T. simplex* was described from Honduras, *alba* from Panama.

Dyar describes *Afrida gymnes* (Seitz 35: b9) and *pnixis* (Seitz 35: b5) from the Canal Zone. The latter has a contrasting blackish base.

Odozana Walker

This is the beginning of the large Illice group, typical of the two Americas. They are all small, usually brightly colored, with well developed palpi and usually with venation of fore wing complete and

[1] The white species at hand may be separated as follows:

1. Antennæ broadly pectinate on basal half..... *new species* (Guiana etc.)
   Antennæ simple or subpectinate..... 2
2. Antennæ with a triangular ventral extension of each segment, twice as wide at tip as base, looking subpectinate from above; scaling of shaft white on basal half, gray toward apex *alba*
   Antennæ with segments rounded, moniliform..... 3
3. Scaling of shaft white, the naked portions yellow..... *parvita*
   Scaling of shaft blackish; the naked parts dull brown..... *melanocera*

hind wing reduced. The larvæ are inconspicuous, with setæ mostly reduced to two or three to a wart; and feed on lichens.

Odozana has Sc and R_1 anastomosing, R_5 stalked beyond R_3 and hind wing with only two veins from lower angle of cell. Male with enormous abdominal tufts in the present species.

1. Disc of thorax orange, base of hind wing below costa and abdomen scarlet. . . . . *sixola*
   Whole thorax blue black; base of abdomen and whole hind wing blackish. . . . . *decepta*

743b Odozana sixola Schaus

O. sixola Schs. Ann. Mag. Nat. Hist. (8) vii, 363, 1911.
Figured: Hamps. Suppl. 34: 36; Seitz 34: 11.

Collar black, but sides of prothorax orange. Dorsal terminal tufts yellow. Female with end of abdomen black.

Chief flight in Nov. (see diagram, p. 163). Costa Rica (type).

743d Odozana decepta Schaus

O. decepta Schs. Ann. Mag. Nat. Hist. (8) vii, 364, 1911.
Figured: Hamps. Suppl. 25: 2; Seitz 24: 5.

Head and thorax brilliant green; tufts mostly red, shorter and more massive than the preceding. Hind wing with red on fringes only.

Oct. to Feb. Costa Rica (type).

Phaulosia Walker (*Saozana* Dyar)

Female venation like the preceding except for the separation of Sc and stalking of M_1. Appearance wholly different, the fore wing being dull colored, with complex pattern including an apical dot; apex marked and outer margin bent. The stalking of R and M_1 of hind wing seems to vary individually, as Dyar reports his specimen with them united, while ours and the B.M. ones are stalked.

Male (Hamps. Suppl. fig. 207) with costa of both wings fringed, and a blister on posterior edge of cell of fore wing and anterior side of hind wing. Hind wing deeply bilobed, the upper lobe with heavy sex-scaling both above and below, containing the whole preanal area. Only three veins arising from cell besides Sc.

I suspect our species is merely the local representative of *P. sordida* Btl., described from one bad ♀.

743a (749?) Phaulosia leucota Hampson

Odozana leucota Hmps. Ann. Mag. Nat. Hist. (7) viii, 184, 1901.
Saozana l. Dyar, Proc. U. S. Nat. Mus. xlvii, 172, 1914.
Figurcd: Hamps. Suppl. p. 663, fig. 207; Seitz 34: 19.
? *Phaulosia sordida* Btl. Trans. Ent. Soc. Lond. 1878, 55.
Figured: Hamps. fig. 267; 34: n3.

Ground light brown, marked with white and blackish, a blackish dot at lower angle of cell and an ocellate one at apex most conspicuous.

Nov.20, 1 ♂, Dec.25, 1 ♀ (Bts.); described from Panama and Costa Rica (*leucota*) and Amazons (*sordida*). French Guiana (Nat. Mus.).

Prepiella Hampson

Like Illice, except that M_3 and Cu_1 of hind wing are stalked or united. The odd pattern, made up of transverse ordinary lines, black vein-lines in ante- and postmedial regions, and red cell spot on a yellow ground, is shared by some species of Illice, Callisthenia, Talara, Barsinella, etc.

1. Antennæ shortly pectinate in male, black; antemedial region with one of the black streaks on Sc. . . . . *pexicera*
   Antennæ simple, no streak on Sc. . . . . *aurea*

754 Prepiella pexicera Schaus

P. pexicera Schs. Jour. N. Y. Ent. Soc. vii, 215, 1899.
Figured: Hamps. fig. 271; Seitz 33: e10.

Black markings moderately heavy; streaks falling short of the black basal bar and terminal line; ordinary lines sometimes meeting below the red discal spot (the type very bad and not clear on this point). The female at hand has the lines separate and the discal spot accompanied by a second red spot below the cell.

Nov. 19, 28 (Bts.). Venezuela (type). Trinidad (Cornell).

755 Prepiella aurea Butler

Mæpha aurea Btl. Trans. Ent. Soc. London 1878, 54.
Figured: Hamps. fig. 272 (venation incorrect, see Dyar' 14); Seitz 33: f1.

The red spot is massive, and black markings lighter; M_3 and Cu_1 are at most very shortly stalked, but the cell is drawn out in a point to meet them.

Oct.-Nov. (Bts.), Apr. (Friedman; also Cornell), July 22, Aug. 2 (Banks). Venezuela, Guiana and Upper Amazons.

Callisthenia Hampson

Wings narrower and more oblong than the preceding, especially the male which has a longitudinal fold through the cell, edged with enlarged scales. Pattern of Prepiella.

Callisthenia truncata, new species

Close to *C. plicata*. Longitudinal fold in cell extending straight out through end of cell (most easily seen as a ridge beneath) its upper side overhung with a ridge of enlarged scales which start at 1/3 cell, get larger outwardly and end abruptly just beyond upper angle of cell. They curve up and away from the groove, but I can see no trace of the continuation along R_3 to costa figured by Hampson for *plicata*.

Yellow, with *Prepiella* pattern. Front black, a black bar between bases of antennæ, which are black except for a yellow subapical patch. Thorax with black tegulæ and mid-dorsal stripe, the latter widening to cover the whole scutellum; abdomen scarlet with yellow base, and massive preapical and apical tufts. Fore wing with veins heavily lined with purple-black, except in a triangle resting on base of inner margin, and median area. Extreme base black; median area narrow, wholly beyond middle of wing, interrupted by a heavy scarlet splash on end of cell; the black antemedial line bent out a little to touch the scarlet spot, and postmedial touching its upper and lower angles, bent out in a sharp semi-ellipse between, enclosing a spot of the yellow ground. Stripes on veins beyond postmedial continuous, joining the black fringe. Space between M_1 and M_3 a little wider than the others. Base of inner margin scarlet. Hind wing scarlet with yellow costa and black apex, the latter drop- or comma-shaped, formed of a rounded area at apex and a tail gradually narrowing toward anal angle. Under side yellow. Fore and middle coxæ black, contrasting, the rest of fore and middle legs black, cut with yellow; hind legs, including coxæ, mostly yellow; abdomen with 5 heavy black segmental bars. Under side of wings scarlet, the costal and dorsal areas of fore wings yellow; thick black streaks along costal edge and upper edge of cell joining in a spot which ends abruptly, leaving a costal yellow patch corresponding to the median fascia above. Apex (beyond m. fascia) solid black. Hind wing as above. 15 mm.

Barro Colorado Id., C.Z., Panama, Oct. 8 and Nov. 4 ♂, Nov. 8 ♀. (Bates).

Dyar described *Palæozana mida* from the Canal Zone (Seitz 66: i7). Fore wing dark, hind wing scarlet with black border; anal tuft fan-like.

Illice Walker (*Cisthene*)

The central genus of this group, which seems to replace *Miltochrista* in the New World. Patterns are varied and lead up to the other related genera. Larvæ on lichens.

1. Fore wing yellow or greenish, marked with black.....2
   Ground of fore wing gray, marked with whitish.....5
2. Fore wing with longitudinal black bars in ante- and postmedial areas (Prepiella pattern).....3
   Fore wing with transverse green-black markings, mimicking Chrysomelidæ.....4
3. Antemedial striped area bounded on both sides by black lines, the basal area clear yellow.....*n. sp.*
   Antemedial stripes not connected by black at their basal ends, the yellow basal area small, as in Prepiella.
   some specimens of *Prepiella aurea*
4. Two broad peacock blue transverse fasciæ.....*opulentana*
   Two narrow fasciæ, crossed by a longitudinal fascia from antemedial to margin, with a more or less complete open circle at their intersection.....*citrina*
5. Fore wing with a longitudinal white stripe in fold.....*minuta*
   Fore wing with a white patch on costa, and inner margin with an interrupted white stripe.....*leuconotum*

790 Illice opulentana Walker

Mæpha opulentana Wlk. List Lep. Ins. Br. Mus. xxx, 1014, 1864.
Figured: Hamps. 28: 11; Seitz 33: p6.

Bands surcharged with brilliant blue; antemedial with two brassy spots; postmedial narrow and broken. Hind wing light yellow (orange in the closely related *I. crœsus* Hmps.).

Oct. 30-Jan. (see diagram, p. 163), Apr. 6 (Bradley, Cornell). Described from the Amazons.

789, 789a Illice citrina Druce

♂ *Cisthene citrina* Dr. Biol. Centr., Am. Het. i, 124, 12: 14, 1885.
Also *figured:* Seitz 33: e2.
♀ *I. tessellata* Dognin, Mem. Soc. Ent. Belge xix, 127, 1912.
Figured: Hamps. Suppl. 35: 35; Seitz 33: e3.

I believe the Seitz figures are too brilliant, both sexes being greenish yellow, but perhaps brighter green when fresh. In the Nat. Mus. specimen of citrina ♂ the lower outer side of the little circle is open, in the female type, and the present 3 females it is complete.

Oct. 22, Nov. 25, Dec. 11 (Bts.). Lancetilla, Honduras (Bts.). Colombia.

There is a single specimen of an apparently new species, superficially almost like *Nodozana bellicula* Schs., but much larger and with the venation of Illice. Cornell has a second specimen (both females) from Surinam.

Dyar reports *I. minuta* Butler (Seitz 33: e3) and describes *I. leuconota* (Seitz 66: i5) from the Canal Zone.

Nodozana Hampson

Very close to Illice, but with R_5 stalked beyond R_3.

1. Brown with three yellow patches..... *thricophora*
   Ground pale..... 2
2. White dusted with cream, with a blackish patch in fold.... *albula*
   More dominantly cream, with a reddish patch..... *picturata*

797 Nodozana thricophora Hampson

N. thricophora Hmps. Cat. Lep. Phal. ii, 375, 1900.
Figured: Hamps. fig. 286; Seitz 34: g4.

Discal spot small, red, in the end of the pale costo-apical spot.

Oct. 10 (Bts.). Described from Chiriqui, Panama.

Dyar also reports *N. picturata* Schs. (Seitz 32: m9) and describes *N. albula* (Seitz 66: h4) from the Canal Zone. He also describes *Serincia* with *S. metallica* (Seitz 66: h3) from the Canal Zone. It has a green fore wing and black hind wing.

Gaudeator Dyar (*Nudur* Dyar)

Practically identical with *Nodozana,* but with a different type of pattern, and costa of fore wing more arched. *G* (?) *phelina* is inter-

mediate, having the wing form of Nodozana, the high M_2 of Gaudeator, and a pattern unlike either. It is put here tentatively, but certainly does not belong with Mulona, either in geography or structure.

1. Black spotted on a cream ground..... *phelina*
   Gray banded on an orange ground..... 2
2. Median stripe independent, running from base to outer margin. *fractivittarum*
   Median stripe starting from middle of antemedial and connected with costal half of postmedial..... *paidicus*

824 Gaudeator (?) phelina Druce

Autocceras phelina Dr. Biol. Centr. Am. Het. i, 139, 13: 13, 1885.
Also *figured:* Seitz 34: c9.

Fore wing white with about 15 black dots; fringe and hind wing yellow. This species is aberrant, but perhaps fits here as well as anywhere. M_2 is a little weak, but perfectly distinct (unlike *Mulona*, which also is purely Antillean). In Hampson's key it would run to the Old World genus *Chionæma*, which is not closely related.

Oct.-Apr. (see diagram, p. 163). Described from Chiriqui. British Guiana (Cornell).

Gaudeator paidicus Dyar

G. paidicus Dy. Proc. U. S. Nat. Mus. xlvii, 164, 1914.
Figured: Seitz 66: h2.

Antemedial line angled at its junction with the medial stripe, lower half of postmedial reduced to a spot.

Oct.-Dec., Apr. (see diagram). Only known from the Canal Zone.

Gaudeator fractivittarum Dyar

Nudur fractivittarum Dy. Proc. U. S. Nat. Mus. xlvii, 368, 1914.
Figured: Seitz 66: k8.

Fore wing shaded with pink; antemedial and postmedial bands both represented by costal and dorsal dashes. Male type with two radials lost, the other specimens seen all normal.

Nov. 4 (Bts.), Apr. 18 (Fried.) both ♀. Mexico (type). Guatemala (U. S. Nat. Mus.).

Lycomorphodes Hampson

Structure like Talara, except the stalked M_2 and M_3. Pattern mimetic of Lycid beetles. Besides the mainland types, there is a Puerto Rico species, corresponding to the local *Correbidia strigosa*.

807 Lycomorphodes sordida Butler

Leptidule sordida Btl. Trans. Ent. Soc. London 1877, 369.
Figured: Hamps. 28: 31; Seitz 34: h2 ♂, 3 ♀.

Dull orange, the darker apex of male cut by a pale dash, female with traces of a midcostal dark spot. The male has a massive coal black tuft on the fore tibia and should be transferred to Hampson's group I.

Oct.-Feb. (see diagram, p. 163); Lancetilla, Honduras, (Bts.). Mexico to Colombia.

Talara Walker

A reduction of Illice, with Sc and R_1 of fore wing anastomosing, and R and M_1 of hind wing fused. M_2 and M_3 of fore wing stalked in subgenus *Abrochocis*, and M_2 and Cu_1 of hind wing sometimes stalked. Patterns varied.

1. Fore wing with black ante- and postmedial lines, red veins and black dusting ..... *esperanza*
   Fore wing with pale markings or no defined markings 2
2. Fore wing scarlet ..... *cara*
   Fore wing white, with two dorsal spots ..... *mesospila*
   Fore wing gray or blackish 3
3. Fore wing with irregular pale ante- and postmedial lines on a shaded light and dark gray ground 4
   Fore wing with broad shades or practically immaculate 5
4. Hind wing and body gray ..... *phœlla*
   Base of hind wing and body pink ..... *mona*
5. Basal third or half of hind wing scarlet 6
   Hind wing wholly dark 7
6. Sides of neck orange; fore wing with vague paler and darker shading; male with most of anal tuft light ..... *rufibasis*
   Sides of neck blackish, concolorous; fore wing with a sparse overlay of slender pale scales; male with whole anal end black. *violescens*

7. Fore wing more or less overlaid with black-tipped pale scales; male with black sex-patch on hind wing.....*melanosticta*
Fore wing evenly scaled; hind wing with M_2 and M_3-Cu_1 wholly united.....*n. sp.*

Group I. *Fore wing with* M_2 *and* M_3 *stalked* (Abrochocis).

808a Talara esperanza Schaus

T. esperanza Schs. Ann. Mag. Nat. Hist. (8) vii, 365, 1911.
Abrochocis e. Dyar, Proc. U. S. Nat. Mus. xlvii, 170, 1914.
Figured: Hamps. Suppl. 36: 25; Seitz 32: n1.

The red veins on an orange ground are distinctive.

Oct. 14-Dec. 3 (Bts.), Apr. 4, 6 (Bradley, Cornell). Described from Costa Rica.

Group II. M_2 *free in both wings* (Talara)

813b Talara cara Schaus

T. cara Schs. Ann. Mag. Nat. Hist. (8) vii, 365, 1911.
Figured: Hamps. Suppl. 37: 1; Seitz 33: o6.

The Barro Colorado specimens do not match any of the named forms exactly. In *cara* type the apical black is more extensive, but shades off into the ground as in these specimens (the figures are inaccurate). *T. rubida* type is evenly crimson without the orange shades, and with no blackish, and *T. coccinea* and *miniata* have a defined median costal black patch.

Oct. 3-Dec. 3 (Bts.), Apr. 11 (Fried.). *T. cara* and *rubida* were described from Costa Rica.

816 Talara rufibasis Felder

♀ *Cisthene rufibasis* Fld. Reise Novara Lep. 139: 4, 1875.
Also *figured:* Seitz 34: c1, 66: g3 (as *minynthadia*).
♂ *T. minynthadia* Dyar, Proc. U. S. Nat. Mus. xlvii, 169, 1914.

Felder's original figure does not show the orange neck, but it is mentioned in Hampson's redescription. Dyar's type of *minynthadia* matches our male. The male is partly shaded with light gray.

Oct. 26 ♂, Dec. 24 ♀ (Bts.), Feb. 7, Mar. 13 (A.M.N.H.), Apr. 9 (Fried.), July 22 (Banks). Described from Colombia.

Talara violescens Dyar

T. violescens Dy. Proc. U. S. Nat. Mus. xlvii, 169, 1914.
Figured: 66: g4.

The female lacks the black tail, and looks identical with the preceding except for the lack of the orange neck.

Oct. 28-Dec. 25 (Bts.), June 20 (Fried.). Described from the Canal Zone.

Group III. *Hind wing with* M_2 *stalked with* M_3-Cu_1

Talara melanosticta Dyar

♂ *T. melanosticta* Dy. Proc. U. S. Nat. Mus. xlvii, 169, 1914.
♀ ? *Lycomorphodes genificans* Dy. Proc. U. S. Nat. Mus. xlvii, 169, 1914.
Easily recognized by the black tipped white scales on the disc.

Oct. 12–29 (Bates), Apr. 4 (Bradley-Cornell), July (Banks). Described from the Canal Zone.

There is a single specimen of a plain mouse gray species, with M_2 and Cu_1 of hind wing united. Dyar also describes *T. mona* and *mesospila* from the Zone (Seitz 66: g8 and g5).

819 Talara phæella Hampson

T. phæella Hmps. Cat. Lep. Phal. ii, 384, 1900, 28: 23.
Also *figured:* Seitz 32: m4.

Described as having M_2 and M_3-Cu_1 connate, in our two specimens they are stalked. The darker gray forms patches at base of wing, costal half of median area, and subterminal costal and dorsal bars.

Nov. 14–15 (Bts.). Described from the Canal Zone.

Dyar describes *Barsinella desetta* from the Canal Zone (Seitz 67: b3). It is a small broad-winged species with the Prepiella pattern.

Dolichesia Schaus

This genus differs from *Talara* in the different wing form and more woolly appearance. *Talara rufa* Schs. from Brazil also belongs to it.

728c Dolichesia falsimonia Schaus

D. falsimonia Schs. Ann. Mag. Nat. Hist. (8) vii, 362, 1911.
Figured: Hamps. Suppl. fig. 202; Seitz 36: c6.

The fore wing is actually dull gray, obliquely banded in several shades.

Oct.-Dec. (see diagram, p. 163). Costa Rica (type).

Clemensia Packard

A broad winged and rather distinct little genus, with ample wings and the dorsal veins spaced, apparently representing the Old World Nudaria group, though more heavily scaled. Larva on lichens. There are a number of species in the Neotropical, all inconspicuous things, the North American *C. albata* being decidedly the most showy of the lot.

858 Clemensia quinqueferana Walker

Tospitis quinqueferana Wlk. List Lep. Ins. Br. Mus. xxviii, 433, 1863.
Figured: Hamps. fig. 313; Seitz 33: m6.

A dull gray, brown or (when rubbed) luteous species, with slightly angled outer margin, and the markings mostly in the shape of marginal spots. Dyar considers the "species" mixed, and if so ours is probably not true *quinqueferana* from the Amazons; but the material seen is too poor to prove anything.

Nov. 1, Jan. 3 (Bts.). Mexico to S. Brazil.

Diarhabdosia Hampson

This genus is a miniature version of the North American *Hypoprepia*, and with *Hæmatomis* forms another little group with reduced palpi. The larvæ feed as usual on lichens, and have most of the warts reduced to single bristles. The moths are excellent mimics of fireflies. The following species is very close to the Guiana *D. cora* Schs. but has a darker hind wing, sex for sex. By a curious chance all the Panama specimens of *coroides* are females (over 30 in all, from three different collections), while all the *cora* at hand, from the Guianas, are males.

1113b Diarhabdosia coroides Schaus

D. coroides Schs. Ann. Mag. Nat. Hist. (8) vii, 368, 1911.
Figured: Hamps. Suppl. 41: 20; Seitz 33: h5.

Scutellum gray, contrasting, hind wing half gray in male, almost wholly gray in female.

Oct.-Apr. (see diagram, p. 163), all females. Panama (U. S. Nat. Mus. and Hamps.), females only. Male seen from Costa Rica.

Paraprepia Dyar (*Parillice* Dyar)

Different in appearance from Illice, of which Hampson considers it a synonym. Blackish, with scarlet prothorax.

Paraprepia fuscilingua Dyar

P. fuscilingua Dyar, Proc. U. S. Nat. Mus. xlvii, 168, 1914.
Figured: Seitz 66: i6.

Oct. 9, 10, 27 (Bts.). Described from the Canal Zone. The other species of the genus (*ruficollis* Schs.) comes from southern Brazil.

Metallosia Hampson

This is the only regional genus of a little group distinguished by having R_5 free and at most R_3 and R_4 stalked. This genus and the other mainland genus, *Chrysozana,* have metallic coloring, the West Indian *Bænasa* and *Torycus* are dull.

Metallosia nitens Schaus

M. nitens Schs. Ann. Mag. Nat. Hist. (8) vii, 369, 1911.
Figured: Hamps. Suppl. 42: 25.

The coloring and radial venation suggest the Glyphipterygidæ, but there is a normal tympanum, though no hood. Green; abdomen and hind wing dull black.

Jan. 12 (Bts.). The present specimen like the unique type from Costa Rica, is a female.

Dyar also describes the following genera and species from the Canal Zone: *Geridixis minx* (Seitz 66: g2). Venation of Chrysochlorosia with R_1 free from Sc. White, with a large blackish dorsal patch.

Anœne with 4 species (Proc. U. S. Nat. Mus. xlvii, 171–172, Seitz 66: g 3–6) with peculiar elongate wing with oblique outer margin, and more Noctuid-like appearance.

Dixanœne lepidocœna (Seitz 66: f7). The only genus with M_3 and Cu_1 of *fore* wing stalked. Finely transversely striate with black and white—with brown ordinary lines, and median and postmedial areas partly overlaid with linear black scales.

Subfamily ARCTIINÆ

Ocellus always present (except in *Lerina*), a little behind base of antenna, and rarely covered in dried specimens by shrinking inside the neck; body normally stout, typically with small head, short palpi and tongue, but with prominent head, palpi and tongue in the great majority of Neotropical species; thorax generally with a pair of glands secreting a colored but usually odorless liquid, most freely used in Utetheisa. The wings are usually strong and their scaling dense, the body frequently with shaggy hair at base. Tympanic hood always present, above spiracle, conspicuous above in some closely scaled forms, but not as large as in the Pericopidæ. Eggs heavily reticulated, spherical, laid in clusters. Larvæ social when young, usually scattering later; with dense tufts of hair (except a few latter genera), the two upper on meso- and metathorax vertically placed; pupa in a cocoon of felted hair (except a few latter genera), various.

A dominant group in all regions, the caterpillars conspicuous, active, and frequently general feeders; the early genera more often on plants with milky sap. Many are "Tussocks", having pencils of long hair at the ends and a less obvious middorsal series, but such are known only from the New World.

Key to Genera

1. Hind wing with a dorsal vein absent (M_3 and Cu_1 fused).....2
   Hind wing with four veins arising from lower angle and side of cell.....15
2. Fore wing with R_2 stalked on R_{3-5}.....3
   Fore wing with R_2 stalked on R_1; hind tibia with terminal spurs only.....*Nezula*
   Fore wing with R_2 free or arising from accessory cell.....12
3. Fore wing with M_3 arising from near end of cell, the width of cell M_3 at base being 1/3 or less its width at margin.....4
   Fore wing with M_3 well separated from lower angle of cell.....6
   Fore wing with M_3 stalked with Cu_1.....*Neonerita*
4. Palpi oblique and beak-like, the second segment not adapted to face; hind wing with R and M_1 stalked, tongue weak.....*Virbia*
   Palpi with second segment concave and adapted to face; tongue strong.....5
5. Palpi as seen in direct front view extending up to middle of front (or level of middle of eye).....*Eupseudosoma*

Palpi as seen from in front extending nearly to top of front and eye. *Premolis*

6. Hind wing with M_2 and Cu_1 stalked[1]. 7
Hind wing with M_2 and Cu_1 arising separately from cell. 9
7. Middle and hind tibiæ with abundant loose hair. . . . . *Castrica*
Middle and hind tibiæ closely scaled. 8
8. Vein closing cell of fore wing nearly vertical. . . . . *Phœomolis*
Vein closing cell of fore wing strongly oblique. . . . . *Robinsonia*
9. Fore wing with R_2 arising beyond origin of R_5 10
Fore wing with R_5 arising beyond origin of R_2 11
10. Palpus as seen in front view upturned to vertex. . *Automolis vitrea*
Palpus as seen in front view upturned to middle of front. . . . *Idalus*
11. Hind wing with R and M_1 free; tibiæ spined. . . . . *Belemnia*
Hind wing with R and M_1 stalked or united; tibiæ not spined. *Automolis*
12. Hind wing with Sc aborted; pattern complex. . . . . *Thalesa*
Hind wing with Sc developed; pattern normally simple 13
13. M_1 free from R and M_2 from Cu_1; abdomen with some loose hair, tending to avoid the midline . . . . . *Glaucostola*
M_1 or M_2 or both stalked. 14
14. M_1 stalked with R beyond the point of separation of M_2 and Cu_1 or completely united; abdomen smooth-scaled. . . . . *Parevia*
M_2 stalked with Cu_1 beyond the point of separation of R and M_1; abdomen shaggy toward base. . . . . *Neritos*
15. Middle and hind tibiæ with small spines on under side toward tips; wings washed with metallic blue or green; tongue strong. . . . 15½
Tibiæ not spined; wings without extensive blue or green areas. . 16
15½. Hind wing with M_2 and M_3 stalked. . . . . *Diospage*
Hind wing with M_2 and M_3 connate. . . . . *Belemniastis*
16. Fore wing with R_2 stalked on R_{3-5} 17
Fore wing with R_2 free or from accessory cell 24
Fore wing with R_2 stalked on R_1 31
17. Tongue weak, palpi hardly exceeding front; hind tibiæ with end spurs only . . . . . *Eepantheria*
Tongue strong, palpi fully developed; hind tibiæ with all spurs. . 18
18. Base of abdomen shaggy. 19
Base of abdomen with at most a little loose hair each side of median line. 21

[1] These have R_2 stalked beyond R_5, — in Amaxia, Hyperandra and some Parevia and Aræomolis R_5 is stalked beyond R_2.

19. Hind wing with M_2 and M_3 separate at origin.....20
Hind wing with M_2 and M_3 more or less stalked; wings rounded, body smooth, pattern simple.....*Tricypha* (part)
20. Hind wing with all veins; M_3 nearer to M_2 than to Cu_1 at origin. *Ammalo*
Hind wing with Sc or R lost; M_3 and Cu_1 approximate or stalked, M_2 more widely separated; apex of fore wing of male frequently turned under.....*Melese*
21. Palpus obliquely upturned, long enough nearly to reach vertex, with third segment half as long as second.....*Metaxanthia*
Palpus with third segment shorter, less than 1/3 as long as second when palpus exceeds middle of front.....22
22. Palpus short, not reaching middle of front.....23
Palpus moderate, slightly exceeding middle of front.....*Agoræa*
23. Palpus slender, third segment half as long as second.....*Bituryx*
Palpus stocky; third segment very small.....*Tanada*
24. Abdomen (and whole insect) closely scaled, slender; accessory cell large and normal.....*Utetheisa*
Abdomen shaggy at base.....25
25. Hind wing with Sc absent, costal edge not lobed; pattern complex.....*Ochrodota*
Hind wing with Sc distinct, or if lost (*Tricypha* occasionally) with a distinct bend in front edge of cell where it was lost, forming a slight costal lobe, and simple pattern of vague shades only.....26
26. Palpi hardly exceeding front, tongue weak; R_2 free.....*Apantesis*
Palpi upturned to middle of front or longer, tongue strong.....27
27. Fore wing with accessory cell.....28
Fore wing with R_2 free.....29
28. Palpus with third segment long and porrect.....*Calidota*
Palpus simply upturned.....*Purius*
29. Palpi longer, the distance from tip of second segment to base of antenna about 1½ times width of scape.....30
Palpi shorter, the distance between tip of second segment and base of antenna more than twice width of scape.....*Halysidota*
30. Pattern of fine striations; venation normal.....*Elysius*
Pattern of broad vague shades; male venation typically modified, with M_1 arising out of R_5 near tip, and meeting M_2 at margin, M_2-Cu_2 closely crowded, and M_3 and Cu_1 connate; Sc of hind wing absent.....*Tricypha* ♂

31. Hind wing with Sc absent ..... *Carathis*
    Hind wing with all veins 32
32. Hind wing with disc transparent and scaling blackish; pointed; fore wing with simple diffuse banding ..... *Baritius*
    Hind wing pale or dull, evenly scaled, rarely pointed; fore wing normally with complex pattern ..... a few *Halysidota*

Tribe PHEGOPTERINI

Larva with dense fine feathery hair, usually forming pencils, and felted with very little silk to make the cocoon; pupa with flattened body, bluntly rounded posterior end and no flange plates in front of abdominal spiracles; imago with prominent head and strong palpi and tongue. Sc of hind wing usually weakened at tip, occasionally lost.

This is a purely American group (except possibly *Rhodogastria*), richly developed in the Neotropical, where it forms almost the complete representation of the Arctiinæ. In the North it is largely replaced by genera of Old World affinity, but still shows several common types. I divide it into four groups of genera, of which the first and last are strictly Neotropical and the last is aberrant, and should probably be transferred to the Euchromiidæ.

Automolis Group

Larva with meso- and metathorax each bearing a single large subdorsal wart (pupa not studied); imago with hind wing reduced in size and one medial lost; lateral lobe of metascutellum convex or bulging, in the Neritos group forming a cushion as wide as the hairy area of the scutum anterior to it.

Robinsonia Grote

The genera of this group are closely related, and I am separating them on the characters used by Hampson. Probably study of the genitalic characters may produce a grouping more like that suggested by their patterns. The tympanal structures show that Neritos is a little separated, but the line of demarcation is still obscure. Larva of *R. dewitzi* on *Lucuma caimito*, tawny brown with dense feathery brown hair and black spotted head. (Ferr. d'Almeida 1929.)

1. Fore wing with only three large white areas along costal part of wing and one small one at anal angle ..... *deiopea*
   Fore wing with five of the small areas along outer margin .. *sanea*

1197 Robinsonia deiopea Druce

R. deiopea Dr. Ann. Mag. Nat. Hist. (6) xvi, 37, 1895.
Figured: Biol. 77: 9; Seitz 44: d5.

Nov. 29 (Bts.). Guatemala to Colombia (Nat. Mus.).

1199 Robinsonia sanea Druce

R. sanea Dr. Ann. Mag. Nat. Hist. (6) xvi, 37, 1895.
Figured: Biol. 77: 3; Seitz 44: e7.

Oct. to Feb. (see diagram, p. 163). Costa Rica to Guiana.

Idalus Walker (*Prumala* Schaus)

I should redefine this genus to include only the species with R_2 stalked beyond R_5 and the palpi upturned to the middle of the front — thus excluding *lineatus*. Prumala is supposed to have R and M_1 of hind wing stalked instead of united; but this is generally merely a female character. Some species have hair on the tibiæ but less than in Castrica. *I. hippia* should probably be transferred to Eupseudosoma, where it resembles the aberrant *marpessa* group.

1. Fore wing white with black pattern ..... *daga*
   Fore wing with base gray (♂) or mottled red, yellow and gray (♀), apical third yellow..... *hippia*

1207 Idalus hippia Stoll

Bombyx hippia Stoll, Suppl. Cr. Pap. Exot. 57, 12: 8, 1790 ♂.
Prumala pyrostrota Dognin, Ann. Soc. Ent. Belge lii, 153, 1908.
Also *figured:* Seitz 45: d1, 2 ♂ 44: i7 ♀ (as *pyrostrota*); Hamps. Suppl. 43: 25 (as *pyrostrota*).

A good series makes this synonymy reasonably certain. Hind wing with large sex patches in male as in some *Eupseudosoma*, and M_2 sharply divergent from Cu_1, touching M_1 at tip. Both sexes with Cu_1 close to M_3 in fore wing, and R and M_1 of hind wing united.

Jan.-May (see diagram, p. 163). Lancetilla, Honduras (Bts.) to Guiana and Amazons.

1212.1 Idalus daga dares Druce

I. dares Dr. Ann. Mag. Nat. Hist. (6) xiii, 354, 1894.
Figured: Biol. 73: 23; Seitz 45: d8.

Body scarlet, orange in typical *daga*, from South America. Hind wing with Sc stalked in ♂, connate in ♀, and R and M_1 united in both sexes.

Nov. 28, Feb. to Apr., June 27. Lancetilla, Honduras (Bts.) to Colombia (Nat. Mus.).

Phæomolis Hampson

This genus is near *Amaxia* in structure and pattern. I believe *Eriostepta* is not distinct. Typically it has R and M_1, M_2 and Cu_1 completely fused, but *P. beata* has them stalked in both sexes.

1. Female with the reddish area which extends from base to anal angle of solid color, except for a *costal* spot, male cut only with a yellow pm. bar; female hind wing blackish..... *beata*
   Both sexes with dark area interrupted more or less completely by yellow ante- and postmedial bands, which are more oblique and converge to inner margin, the ground grayer; female hind wing red..... *lepida*

1216a Phæomolis lepida Schaus

P. lepida Schs. Ann. Mag. Nat. Hist. (8) ix, 38, 1912.
Figured: Hamps. Suppl. p. 26, fig. 9.

Sex patch moderate; male hind wing with Sc from end of cell; female with Sc, R and M_1 long-stalked.

July-Aug. (Fairchild), Dec. (Bts.). Costa Rica (type).

1232c Phæomolis beata Dognin

Eriostepta beata Dgn. Ann. Soc. Ent. Belge liii, 219, 1909.
Figured: Hamps. Suppl. p. 65, fig. 16.

Both sexes with M_2 short-stalked and sharply divergent from Cu_1 (apparently overlooked by Hampson). Sex patch large, lower on the wing than figured by Hampson; Sc from middle of upper side of cell in male, from apex in female, which has R and M_1 very long-stalked.

Feb. 4, 26 (Bts., Fried.) Lancetilla, Honduras (Bts.) to French Guiana (type) and Peru (B.M.).

Eupseudosoma Grote

I transfer to this genus *Automolis aletis*, which agrees in both structure and appearance, and should probably add *Idalus hippia*, but the

latter is aberrant in appearance, though typical in structure. The white species are very close, and perhaps should be increased in number. Larva of *E. involutum* (Sepp) and *floridum* (Dyar) with yellow head and yellow to gray hair, the pencils white; on Eugenia and guava.

1. Outer third of fore wing pale yellow, contrasted with the reddish and gray base..... *Idalus hippia*
   Ground all white..... 2
2. Fore wing with a median fascia composed of black streaks between the veins, and a subapical dot..... *aletis*
   Fore wing immaculate, or with black costal edge and two longitudinal gray or black lines only..... *aberrans*

1229a Eupseudosoma aberrans Schaus

E. aberrans Schs. Proc. U. S. Nat. Mus. xxix, 211, 1906.
Figured: Rothschild, Nov. Zoöl. xvi, 4: 24; Seitz 50: a3.

The species of this group differ in the amount of pink; the present one having a mere trace or none on the neck, and none on the fore coxæ, but sometimes some on the male hind wing. *E. involutum* has pink coxal patches, *E. floridum* more pink on the neck, and frequently pink-shaded hind wings, and *E. agramma* lacks the male sex-patch. All the species come with or without the two dark lines on the fore wing.

Dominant in Feb. (see diagram, p. 163). Costa Rica to S. Brazil.

1247a Eupseudosoma aletis Schaus

Automolis aletis Schs. Ann. Mag. Nat. Hist. (8) vi, 200, 1910.
A. aleteria Schs. Proc. U. S. Nat. Mus. xxix, 214, 1905.
Figured: Hamps. Suppl. 45: 25 ♂, 26 ♀, 24 (♂ as *aleteria*); Seitz 50: i7 ♂, 8 ♀, 6 ♂ (as *aleteria*).

Male with sex patch as in the preceding. Pattern as in *Idalus hippia*, but with fewer black bars on fore wing and some pink on hind wing.

Jan. 28 (Bts.). Costa Rica to Guiana and Upper Amazons.

Premolis Hampson

Identical with *Eupseudosoma* except for the longer palpi. The following species has the essential pattern of the *marpessa* group, and is even closer to *Hyperandra appendieulata*, but shows the structural characters of Premolis.

Premolis excavata, new species

Palpi upturned (in front view) to the level of the vertex, third joint short; antennæ subserrate. Fore wing with outer margin much longer than inner; R_2 short stalked on R_{3-5}, M_1 nearly connate; Cu_1 from very close to M_3. Hind wing with Sc arising from before middle of cell, R and M_1 united, ending abruptly at outer edge of stigma and not reaching margin of wing; M_2 and Cu_1 connate, M_2 and M_3 separating in the specimen at hand in a minute fork just before margin. Sex patches enormous, on the fore wing extending up into cell and over Cu_2, and surrounded by a glossy stripe; in the hind wing covering all the wing except the margins and anal lobe. Anal lobe truncate, much shorter than greatest length of wing, which forms a broad lobe on M_2-Cu_1.

Head brown, including antennæ and most of palpi; front and first segment of palpi cream; vertex bright yellow. Thorax with anterior third pure white, the boundary cutting squarely across disc and tegulæ; disc otherwise yellow, with anterior and posterior pairs of blackish spots; tegulæ, except in front, and scutellum light brown-gray. Abdomen yellow, with whitish tail. Under side yellowish white, the fore and middle legs tinted with pale gray-brown. Fore wing pale brown-gray, with pale veins, and broader pale streaks on middle of cell and fold, the Sc streak also widened and ending abruptly without touching margin. Outer margin with a light yellow patch, starting abruptly at M_1 and tapering regularly to a point on margin at fold. Hind wing pale yellow. Under side pale yellow with a squarish apical patch of pale brown-gray. 30 mm.

Barro Colorado Id., C.Z., Panama, Jan. 26, 1935 (Bates); unique male type in M. C. Z.

The nearest species is *Hyperaudra appendiculata*, which has a much larger anal lobe, M_1 and M_2 both stalked, and the marginal yellow area tapering off to the apex. In all the Premolas the marginal area is much larger, extending in about to end of cell. If the minute tip of M_3 is considered normal the species will key to Tricypha in the present paper, to Bertholdia in Hampson. The former has ample hind wings and a normal, grooved lateral lobe of the metascutellum, the latter has M_3 and Cu_1 stalked instead of M_2 and M_3.

Neritos Walker (*Paranerita*, *Hyponerita* Hampson)

This little group is distinguished by the much enlarged bulla over the tympanum (formed by the lateral extension of the metascutellum).

Hampson has failed to see the accessory cell in *N. repanda*, the genotype, and proposed the names *Paranerita* and *Hyponerita* for species in which he did see it. In fact all the specimens examined have it. R_1 may arise free or from the anterior side of the acc. cell, sometimes varying in the same species, but it is from the acc. cell in all the specimens examined of *N. repanda* and *metaleuca*, and free in *N. cotes*.

1. Abdomen deep yellow above..... *cotes*
   Abdomen scarlet above..... *metaleuca*

1544a Neritos metaleuca Dognin

N. metaleuca Dgn. Het. Nouv. Am. Sud. iii, 13, 1911.
Figured: Hamps. Suppl. 45: 8; Seitz 46: d6 (both of ♂).

Very close to *N. repanda*, distinguished by the small middorsal yellow spot or bar on first segment of abdomen, and complete absence of yellow or red antemedial markings on fore wing. Male with a rounded subapical patch separate from the dark basal half, female with the two connected by a gray bridge, leaving costal and anal pale yellow patches.

Jan., June (Fried.) all ♀, described from a Venezuela ♂. The Cornell coll. has a ♂ without locality, but associated with Central American material.

1549 Neritos cotes Druce

N. cotes Dr. Ann. Mag. Nat. Hist. (6) xviii, 38, 1896.
Figured: Biol. 73: 24 ♂; Seitz 46: f1, 2 ♀.

The apical patch and dark base may be either separate or connected in male, usually at least connected in female. This species has the vertex with a large yellow spot, some blackish marginal shading on hind wing below, and costal edge of fore wing red, at least toward tip. *N. tipolis* has no red on costal edge, and no black on hind wing below; *N. samos* Dr. is much more red, with the vertex mostly red.

Chief flight in Feb.-Apr. (see diagram, p. 163). Ranges north to Guatemala and south at least to Colombia.

Neonerita Hampson

Similar to Neritos. First segment of abdomen with a massive white dorsal tuft, second with a slightly raised white spot. Fore wing with R_2 stalked on R_{3-5}, M_3 and Cu_1 stalked.

1244 Neonerita dorsipuncta Hampson

N. dorsipuncta Hmps. Cat. Lep. Phal. iii, 37, fig. 30, 1901.
Also *figured:* Seitz 45: h3.

Fore wing transparent yellow, basal half and apical patch light buff, mottled with pink and brown, hind wing pink; abdomen scarlet and pink.

Feb. 26 (A.M.N.H.). Mexico to Brazil.

Parevia Hampson

The following species is aberrant in having R_1 free, — it would run to Neritos in Hampson's key, but differs in the absence of acc. cell and completely smooth abdomen.

1. Fore wing with marginal yellow patches..... *parnelli*
   Fore wing immaculate gray..... *griseotincta*

1246g, 1246h Parevia griseotincta Rothschild

Neritos griseotineta Roth. Nov. Zoöl. xvi, 291, 1909, ♀.
Neritos affinis Roth. Nov. Zoöl. xvi, 292, 1909, ♂.
Nezula grisea Dyar, Proc. U. S. Nat. Mus. xlvii, 173, 1914 (not Schaus).
Figured: Hamps. Suppl. p. 121, fig. 48 ♂ (as *affinis*), 45: 20 ♀; Seitz 46: k5 ♂ (as *affinis*), 6 ♀.

Male with abdomen slender, pink with gray penultimate and whitish last segment; and hind wing pink below costa; female with hind wing and abdomen concolorous mouse gray; both sexes with deep yellow head. The male has loose sex-hair on hind tibiæ. The true *N. grisea* has a more hairy abdomen and dark hind wing in both sexes, also has lost the upper tibial spurs.

Nov., Feb. (Bts.), Jan. (Fried.), Feb., Mar. (A.M.N.H.). Venezuela, Surinam and Amazons.

Dyar reports *P. parnelli* Schaus (Hamps. Suppl. 45: 18) from the Zone.

Glaucostola Hampson

Very close to Neritos and Parevia, differing in the connate M_3 and Cu_1 of hind wing. Acc. cell present or absent; abdomen scaled, or lightly hairy, as in *N. repanda* female.

1. Fore wing gray with a white spot..... *guttipalpis*
   Fore wing with yellow spots and black lines..... *reimona*

1343 Glaucostola guttipalpis Walker

Leucopsumis guttipalpis Wlk., List Lep. Ins. Br. Mus. vii, 1649, 1856.
G. underwoodi Roth. Nov. Zoöl. xvii, 187, 14: 3, 1910.
Figured: Hamps. fig. 63; Seitz 42: f2, I (*underwoodi*).

This is the genotype, and has R_2 free. Head yellow, hind wing black with a white dash. The following specimen will be *G.g. underwoodi*, with the dash on the hind wing less than ¼ the width of the wing. Type *G. guttipalpis* is from Brazil.

Oct. 31 (Bts.). Costa Rica to Brazil.

Glaucostola reimona Schaus

G. reimona Schs. Ann. Mag. Nat. Hist. (10) xi, 571, 1933.

The abdomen and hind wings are solid yellow. Hind wing with R and M_1 stalked.

Feb. 24, Mar. 15, 17, 20 (A.M.N.H.), Apr. 4 (Friedman). Described from Colombia.

Automolis Hübner

A large and varied genus, — of about 180 species, all strictly Neotropical. Many more species will certainly be taken on the island. Secondary sexual structures and patterns are extremely varied, and the genus is probably not homogeneous, being accepted here as defined by Hampson. The few known larvæ are varied (see Seitz under *A. sypilus* and *sanguinolenta* Cr.).

Synopsis of species-groups, after Hampson

Sect. I: Hind wing of male with costa highly lobed, a sex-patch on upper side below costa

A. Hind wing with Cu_1 from or from near angle of cell; M_2 from above angle; ♂ with R and M_1 coincident, and Sc from middle of cell; ♀ with Sc and R stalked

a. Male antennæ bipectinated . . . . . *critheis*

b. Male antennæ serrate and fasciculate. Fore wing of male without glandular swelling on costa and hind wing without long hair on costa

a_2 Hind wing with large anal lobe and pencil. . . *reducta*

b_2 Hind wing not modified dorsally . . . . . *lineatus*

B. Hind wing of male with Cu_1 from angle of cell, R and M_1 stalked; male antennæ minutely serrate and fasciculate; fore wing with sex patch below middle on under side.
obscurata

Sect. II: Hind wing of male not lobed and without sexual patch

A. Male antennæ bipectinate, with short branches; hind wing of male with Sc and R stalked, anal angle not lobed.. *metallica*

B. Male antennæ serrate and fasciculate. Hind wing of male with Sc from cell, the anal angle not lobed

a_2 Palpi with third joint long and close-scaled; fore wing R_2 long-stalked, hind wing of male with R and M_1 stalked (*Ischnognatha*)..... *vitrea*

b_2 Palpi with third joint short

a_3 Hind wing of male with R and M_1 coincident.
lineosa, sicilia

b_3 Hind wing of male with R and M_1 stalked.
diluta, rutila

Key to Species

1. Body spotted with metallic blue.....2
   Body without metallic markings.....3
2. Wings and disc of thorax yellow or orange; fore wing with black and white apical spot; body with orange on one or two basal segments..... *sicilia*
   Wings and disc of thorax blackish; fore wing with a yellow longitudinal stripe narrowed or interrupted beyond cell and pale veins..... *metallica*
3. Fore wing with fine black lines midway between veins; body red to yellow.....4
   Fore wing without fine longitudinal black lines.....6
4. Body yellow.....5
   Body red. Wing striate on a buff ground, the apical part not contrasting with the rest..... *lineosa*
5. Outer half of wing translucent white, with subterminal black dots..... *vitrea*
   Outer half of wing striped like base, on a yellowish ground.
   lineata
6. Body blackish, fore wing with black base.....7
   Body red; ground light.....8
   Body buff; fore wing yellow with two gray bands..... *reducta*

7. Fore wing with a transverse black median stripe, cut by the fine white veins..... *critheis*
   Fore wing with base brown, apical part light yellow with dark subterminal spots, the yellow more extensive in the ♂. *obscurata*
8. Fore wing with black basal patch and a yellow costal stripe from the end of this patch to apex; abdomen almost wholly blackish. *diluta*
   Fore wing with ground blackish, finely veined with yellow; a yellow postmedial fascia and yellow side patches on abdomen. *rutila*

1250 Automolis reducta Walker

A. reducta Wlk. List Lep. Ins. Br. Mus. vii, 1638, 1856.
Creatonotus lobifer H.-S. Aussereur. Schm. 84, fig. 503, 1856.
Also *figured:* Hamps. fig. 35; Seitz 52: e1.

Pale yellow; fore wing with light gray fascia on basal half of costa, and a more diffuse one from middle of inner margin to apex; hind wing of male with deep anal lobe and hair-tuft.

Mar. 8 (A.M.N.H.). Costa Rica to southern Brazil.

1247 Automolis critheis Druce

A. critheis Dr. Biol. Centr. Am. Het. i, 89, 9: 19, ♀, 1884.
Also *figured:* Seitz 50: k7 ♀.

In the male the hind wing is relatively smaller, and the yellow median area stops below the cell, leaving the dorso-median area white. In the closely related *A. herois*, which ranges from Mexico to Brazil, the male antennæ are serrate, and the black bars on the fore wing are broader and less intense.

General (see diagram, p. 163), Mar. 26 (Bradley-Cornell). Ranges to Surinam and S. Brazil.

Automolis obscurata Schaus

A. obscurata Schs. Proc. U. S. Nat. Mus. lvii, 116, 1920 (*obscurata* Seitz 52: f7 is not this species).

In the male the dark base of the fore wing is cut off at about 2/3 by a moderately waved boundary, the apical area has a couple of pm. and fairly complete series of terminal spots and the hind wing is pale. In the female the brown area is much darker and more extensive,

covering all but the most apical of the st. spots, and the hind wing is dark gray. Palpi white.

In the closely related *A. sanguistrigata* Dgn. (♀ *submarginalis* Schs.) from South America the effect is duller, the red stripe on the tegulæ evanescent, the female hind wing pale and the palpus crimson. (Seitz 52: f6 ♂, g1 ♀ as *submarginalis*).

Flight scattering (see diagram, p. 163). Guatemala (type).

1258d Automolis metallica Joicey

A. metallica Jcy. Ann. Mag. Nat. Hist. (8) xviii, 57, 14: 7, 1916.
Also *figured:* Seitz 50: c2 ♂.

In this species the pale veins are distinct and the orange streak varies extremely but is always narrowed or interrupted and may be reduced to a wedge below the cell and a subapical spot. In *A. guapisa* Schs. the stripe is even and the veins fainter; in *A. tæniata* the fascia is continuous, broad, fairly even and pale yellow, and the veins are not pale at all. In this species the fore tibiæ and tarsi and mid and hind tarsi are yellow, contrasting, in *A. rosenbergi* they are blackish with yellow streaks only.

Oct. 29-Mar. 22. Lancetilla, Honduras (Bates). Described from Chiriqui.

1289 Automolis vitrea occidentalis Roth.

[*Bombyx vitrea* Stoll, in Cr. Pap. Exot. iii, 151, 276: C, 1780.]
A. vitrea, occidentalis Roth. Nov. Zoöl. xvi, 47, 7: 4, 1909.
Also *figured:* Seitz 52: g5 (type form), h1 (*v. borealis*), h2 (*v. meridionalis*).

The type form is from Surinam, *borealis* from Central America, *meridionalis* from Paraguay; the Barro Colorado specimens come nearest the Peruvian *v. occidentalis*, the ground being redder and black lines finer than in *borealis*, which is in the present collection from Honduras.

Dec. (Bts.).

1290 Automolis lineosa Walker

Idalus lineosa Wlk. Char. Lep. Het. 10, 1869.
Figured: Hamps. 36: 4; Seitz 52: d1.

Dec. (Bts.), Guatemala (Bequært) to Colombia, the race *sublineata* Roth. (Seitz 52: d2) in Peru.

1206, 1290a Automolis lineatus Druce

Evius lineatus Dr. Biol. Centr. Am. Het. i, 89, 9: 17, ♂, 1884.
Automolis internervosa Dgn. Het. Nouv. Am. Sud v, 10, 1912 ♀.
Also *figured:* Hamps. Suppl. 46: 25 ♀; Seitz 45: d3 ♂, c7 ♀ (as *internervosa*).

Venation and palpi normal for Automolis. Male with very large sex patch on hind wing and pencil on under side of fore wing, more as is normal in Neritos.

Oct., Dec., Feb. (Bts.). Guatemala to Venezuela.

1294 Automolis sicilia Druce

A. sicilia Dr. Biol. Centr. Am. Het. i, 75, 1884.
Figured: Biol. 72: 17 (as *parma* Schs.); Seitz 50: f7.

The outer edge is very narrowly edged with black, but broadly in *contraria*, the only other species with the black and white apical spot.

Nov. 29-Feb. 1 (see diagram, p. 163). Ranges north to Mexico.

1301 Automolis diluta Felder

Cratoplastis diluta Fld. Reise Novara Lep. 102: 8, 1874.
Also *figured:* Seitz 52: c1.

The single diffuse yellow costal stripe from near base to apex is distinctive.

Oct. 29-Feb., Mar. 11, 18, May 30, June 4 (Bts. and Fried.). Mexico to Para, Amazons. Represented in southern Brazil by the species or subspecies *catherinæ*, which has the gray area darker and more extensive.

1303 Automolis rutila Stoll

Sphinx rutilus Stoll in Cr. Pap. Exot. iv, 183, 382: B, 1781.
Ischnognatha striata Druce, Ann. Mag. Nat. Hist. (6) xv, 45, 1895.

The yellow postmedial fascia is of moderate width, in the closely related *A. godmani* Dr. (Biol. 9: 1) it is broadened almost to the apex.

Jan. 26, Feb. 9, Apr. 10, May 24. Described from Surinam (*rutila*) and Costa Rica (*striata*).

Castrica Schaus

R_2 long stalked; M_2 and Cu_1 of hind wing strongly stalked; hind tibiæ with long loose hair. The pattern of olive gray and light yellow is distinctive and the few nominal species are perhaps really races.

1308 Castrica phalænoides Drury

Sphinx phalænoides Dru. Ill. Exot. Ent. ii, 28: 6, 1773.
Castrica oweni Schaus, Jour. N. Y. Ent. Soc. iv, 136, 1896, ♀.
Also *figured:* Hamps. fig. 51; Seitz 53: b6 ♂, 7 ♀; Biol. 74: 13.

The South American *C. sordidior* is probably merely a race with darker male hind wing, but the ranges overlap.

Dec. 29 (Bts.). Guatemala to Guiana and Bolivia (*sordidior*).

Halysidota Group

Meso- and metathorax of larva each with two subdorsal warts; the feathery hair usually forming both massive tufts and pencils (no pencils in Calidota). The few known pupæ highly glossy, in cocoons composed almost wholly of felted hairs, the short hairs inserted endwise. Imago with hind wing almost always ample and normally fully veined; side lobes of metascutellum very narrow and strongly concave; abdomen with shaggy dorsal hair. Larvæ so far as known general feeders, most typically on trees.

Melese Walker

This genus, with the closely related *Bertholdia* and *Cissura*, is transitional to the preceding, with reduced hind wing and normally with a gland below cell in male. About half the species have the apex of the male fore wing turned down at right angles or folded under, and colored more like the under sides. These males are relatively rare in collections, and have perhaps often been discarded as damaged specimens.

1. Fore wing with a translucent subterminal costal bar; male with apex folded under..... *asana*
   Fore wing with outer border yellow at least, the male more extensively yellow; female with a separate spot just beyond cell. *laodamia*
   Fore wing without conspicuous yellow markings..... *incerta*

1317 Melese incerta Walker

Malabus incertus Wlk. List Lep. Ins. Br. Mus. iii, 716, 1855.
Figured: Hamps. 37: 6; Seitz 43: k1 (poor and doubtful).

Fore wing with outer margin concave, edged with pink; hind wing with M_3 and Cu_1 stalked.

Chief flight in Dec. (see diagram, p. 163). Ranges south to Brazil.

1320 Melese asana Druce

Neritos asana Dr. Biol. Centr. Am. Het. i, 90, 9: 21, 1884.
Also *figured:* Seitz 43: k4 ♂, 5 ♀; Hamps. fig. 57.

The folded outer margin of male is not shown in Hampson's figure 57. Outer margin of female convex, M_3 and Cu_1 of hind wing connate. Subapical spot much larger in female.

Chiefly Dec.-Jan. (see diagram). Mexico to south Brazil, the latter form being a slight race (*albogrisea* Roth.). The lot includes only 1 male to 12 females.

1322 Melese laodamia Druce

Neritos laodamia Dr. Biol. Centr. Am. Het. i, 90, 9: 20 ♂, 1884.
Neritos cutheans Dr. Ann. Mag. Nat. Hist. (6) xviii, 40 ♀, 1896.
Also *figured:* Seitz 43: f5 ♂, 6 ♀.

Apex not folded; M_3 and Cu_1 connate or slightly separated. The complex male pattern begins to be suggestive of *Amaxia*, the female of *Neritos*. One of the two males from Honduras is slightly suffused.

Nov.-Feb. (Bts.), Mar. 11 (A.M.N.H.), July-Aug. (Fairchild). Lancetilla, Honduras (Bts.), August. Mexico to Trinidad.

Ammalo Walker

I am restricting Ammalo to the typical group, which differs from Halysidota only in the stalked R_2. Antennal pectinations with a few fugitive scales; heavily bristled. The caterpillar is presumably a general feeder, like Halysidota.

1337 Ammalo helops Cramer

Bombyx helops Cr. Pap. Exot. i, 72, 72: C, 1775.
Halesidota megapyrrha Walker, List Lep. Ins. Br. Mus. xxxi, 308, 1864.
Also *figured:* Hamps. fig. 61; Seitz 53: h4 (typical) h5 (var. *megapyrrha*).
Larva: Dyar, Proc. Ent. Soc. Wash. xiii, 229, 1911; Hamps. Suppl. 194, 1920; Seitz p. 385.

Body orange with black spots, hind wing orange, fore wing with vague striation in two shades of brown, and some orange spots, in var. *megapyrrha* confined to the base.

July-Aug. (Fairchild). Mexico to Brazil.

Larva reddish or brownish, with short tufts of black hair.

Baritius Walker (*Pachydota* Hampson)

This genus differs from those species of *Halysidota* that have R_1 and R_2 stalked, only in habitus. The two names are separated in Hampson's key by the (barely) separate or stalked M_1 of fore wing. In fact M_1 is frequently connate in both (as noted in Hampson's own descriptions) and there is no difference except in habitus.

1. Abdomen black with red terminal segments..... *hæmorrhoides*
   Abdomen with brown base, extended in middorsal area, and black segmental lines.....2
2. Abdomen yellow..... *punctata*
   Abdomen vermilion..... *superba*

1365 Baritius superba Schaus

Aclytia superba Schs. Ent. Am. v, 89, 1889.
Figured: Biol. 73: 19; Seitz 42: g1.

The vague dark transverse bands are irregular and anastomose near the middle of the wing; top of head dark; abdomen more red than *B. punctata.*

Feb. 12 (A.M.N.H.). Mexico to Peru.

1353 Baritius punctata Rothschild

Baritius punctata Roth. Nov. Zoöl. xvi, 274, 1909.
Baritius albiceps Hamps. Cat. Lep. Phal. iii, 94, 1901 (in part, not Wlk.).
Pseudapistosia saduca Dr. Biol. Centr. Am. Lep. ii, 381 (in part), 76: 1.
Also *figured:* Seitz 55: k5 (k6 shows the black tail and so is presumably *B. albiceps*).

Fore wing with four or five subparallel dark bands; abdomen blackish at base, but yellow at apex. In *B. sadima* the base of the abdomen is yellow, in *B. albiceps* the apex is black.

Feb. 8 (A.M.N.H.), July-Aug. (Fairchild). Honduras to Surinam at least.

1364b Baritius hæmorrhoides Schaus

B. hæmorrhoides Schs. Proc. U. S. Nat. Mus. xxix, 223, 1905.
Figured: Hamps. Suppl. 49: 2; Seitz 42: f7.

Fore wing with dark base, border and one band only. Male with a

pad of yellow hair at base of abdomen below. The closely related *B. pyrrhopyga* from Brazil has the thorax and male coxae red.

Nov. to June (see diagram, p. 163). Described from French Guiana.

Carathis Grote

Similar to Halysidota in structure and pattern, Sc of hind wing lost; hind wing with M_3 and Cu_1 stalked (not M_2 and M_3 as usual in Halysidota). The following species stands as a Baritius in Hampson but has both the structure and pattern of Carathis.

1368 Carathis eleuthera Stoll

Bombyx eleuthera Stoll in Cr. Pap. Exot. iv, 159, 371: A. 1781.
Also *figured:* Seitz 42: h2 (unrecognizable).

Fore wing light buff with confused series of dark-ringed spots as in many Halysidotas. Hind wing pale yellow tinged with pink, shorter than in most Halysidotas.

Nov. 22-Feb. 24 (Bts.). Surinam, Ecuador, Bolivia.

Ochrodota Hampson

Like Carathis, but with R_1 and R_2 free. Pattern essentially as in Carathis, but suffused with brown, leaving relatively small areas with the ocellate pattern on buff. Specimens with the essential pattern of *pronapides* range from Guatemala to S. Brazil, and stand under various (too many) names.

1347 Ochrodota pronapides Druce

Zatrephes pronapides Dr. Ann. Mag, Nat. Hist. (6) xiii, 173, 1894.
Figured: Biol. 74: 3; Hamps. fig. 66; Seitz 43: a7.

Hind wing almost pure yellow, abdomen yellow with a few paired black spots.

Jan. to Mar.; July-Aug. The type was also from Panama.

Tricypha Möschler

Male with venation more or less modified; female with R_2 stalked, M_2 and M_3 short-stalked; both with Sc of hind wing lost. The genus is a slight variant of Pelochyta, and has the same pattern.

1369 Tricypha imperialis Heylærts

Romanoffia imperialis Heyl. Comptes-R. Soc. Ent. Belge xxviii, p. xcv, 1884.
Figured: Rom. Mem. ii, 9: 1; Seitz 42: i2 (♂).

Male with R_2 from apex of cell, M_1 bent to form almost a quadrant, giving rise to stalk of R_{3+4} and R_5 from its upper side and joining M_2 at tip. M_2-Cu_2 closely crowded; M_3 and Cu_1 short-stalked. Female with R_2 normally stalked, M_2 and M_3 stalked in both wings. Dull gray with three more or less distinct darker transverse bands, interrupted by the modified areas in the male; coxæ yellow with black spots, abdomen yellow, the upper side almost covered with a brown patch.

The series contains only 1 ♀ to 21 ♂s.

Nov.-Feb. (see diagram, p. 163). Lancetilla, Honduras, Apr. (Bts.). Mexico to Amazons and Bolivia.

Pelochyta Hübner

Similar to Halysidota, more slender; palpus longer, upturned well beyond middle of front, third segment about half as long as second; fore wing with M_3 and Cu_1 about ¼ as far apart at origin as Cu_1 and Cu_2. Wings without pattern.

1373a Pelochyta misera Schaus

P. misera Schs. Ann. Mag. Nat. Hist. (8) vii, 184, 1911.
Figured: Hamps. Suppl. 49: 11; Seitz 55: a3.

Both wings alike, dark fuscous with a purplish gloss; head, collar and under side of body yellow. Male (type only seen) smaller and darker.

Jan. 30 (Bts.). Types from Costa Rica.

Elysius Walker

Similar to Halysidota except for the longer palpi. The fore wing is covered with more or less obvious very fine striation or flecking, unlike Tricypha, which may perhaps show the same venation at times.

1. Fore wing with areas of yellow, striated with red..... *conspersa*
   Fore wing dull fuscous, with faint luteous striation... *disciplaga*

1385 Elysius conspersa Walker

E. conspersus Wlk. List Lep. Ins. Br. Mus. iii, 714, 1855.
Figured: Biol. 9: 25; Seitz 54: c2.

Head, thorax and shaggy hair orange, abdomen striped black and yellow; fore wing with three separate yellow and orange patches.

Dec. 27 (Bts.). Panama to So. Brazil.

1393 Elysius disciplaga Walker

Halesidota disciplaga Wlk. List Lep. Ins. Br. Mus. vii, 1709, 1856.
Figured: Hamps. 38: 15; Seitz 54: d6.

Dull brown, including head; abdomen yellow with a large mid-dorsal brown patch; hind wing pale. Hampson mentions black lateral spots and a basal spot which these specimens lack.

Nov. 10 (Bts.), Feb. 15 (Fried.). Mexico to Bolivia.

Thalesa Schaus

Very close to Halysidota, with the exact pattern of the *catenulata* group. Hind wing with one dorsal vein lost, Sc obsolescent; inner margin of fore wing expanded, strikingly so in male.

1472 Thalesa citrina Sepp

Phalæna citrina Sepp, Ins. Surinam, 113, 53, 1848.
Also *figured:* Hamps. fig. 89; Seitz 57: f6 (normal), 7 (dwarf race *parva* Roth.).
Early stages: Sepp, l.c.

Male easily distinguished from the *catenulata* group by the *broad* brown inner marginal stripe; female with discal spot deeply marked or possibly ocellate. The closely related *T. texta* has a black discal *bar*, and *T. debilis* Schs. is paler and has no silver dot.

July-Aug. (Fairchild), Feb. (Bts.), Feb. 24, Mar. 2 (Fried.), 13 (A.M.N.H.), Nov. 15 (Bts., — the only male in the lot). Widely distributed.

Larva apparently variegated, with series of truncate grayish dorsal and lateral tufts, and long white hair at both ends; on Inga.

Halysidota Hübner

Palpi upturned to middle of front (longer in *maroniensis*) with third segment short. Base of abdomen shaggy. Fore wing with R_2

free, rarely shortly stalked with R_1 or R_{3-5}, M_3 and Cu_1 half as far apart at base as at margin, and more than 1/3 as far apart as Cu_1 and Cu_2 at origin (except *sobrina*). Hind wing with Sc not reaching margin, M_2 and M_3 connate or stalked.

Larva with dense fine feathery hair, often covering body, with a series of fine short dorsal pencils, and long pencils at both ends. Food of trees and shrubs (*cinctipes* group) or grasses (*longa* group). Pupa highly glossy, the short hairs worked perpendicularly through the meshes of the cocoon.

The genus is large, varied, and full of close species. It will not be fully understood until the genitalic characters have been worked out, and far more larvæ known. I follow the original spelling of the name, justified by the Greek equivalent. The spelling with *i* was based on a misprint, which was taken up in indexing; *e* was a further mistake of Walker's.

1. Fore wing with light olive veins on a cream ground only. *iridescens*
   Fore wing with transverse markings or ocelli. 2
2. Fore wing with about 25 red-centered yellow ocelli. . . . . *grandis*
   Fore wing not marked with red. 3
3. Fore wings with smooth-tinted darker transverse bands, finely edged with black. . . . . *interlineata*
   Fore wing without black-edged bands, the black when present in the form of lunules or dusting. 4
4. Fore wing with a more or less distinct dark oblique shade extending from lower angle of cell to apex, or part of that distance. . . 5
   Fore wing without an oblique subapical shade. 7
5. Fore wing with R_2 stalked on R_{3-5}; apical shade strong at end of cell, fading out or lost toward apex. . . . . *strigulosa*
   Fore wing with R_2 free; apical shade strongest toward apex. . . . 6
6. A conspicuous black spot at lower angle of cell; ground deeper yellow. . . . . *tabernilla*
   No special spot at lower angle of cell, the discal spot as high as cell and of the same light brown as the other markings as a rule; ground paler straw, with fine yellow-brown markings. . . *angulata*
7. Inner margin of fore wing edged with dark brown as in Thalesa, either finely or somewhat suffused up. 8
   Inner margin of fore wing pale, concolorous. 9
8. Discal spot inconspicuous, incorporated in the contrasting brown postmedial shade; ground darker. . . . . *catenulata*

Discal spot contrasting, white, outlined with brown, the inner side of the annulation continued as a black bar to upper angle of cell; larger and paler. . . . . *annulosa*

9. Male with sex-scaling on cell below; fore wing deeper ochre with very irregular umber brown flecking, gathering in patches at end of cell and antemedially at costa. . . . . *sobrina*

No sex-scaling; male antennæ very large; fore wing pale, with numerous rather evenly darker lunulate lines and a white-centered but somewhat imperfect ocellus at lower angle of cell. *maroniensis*

1486b Halysidota maroniensis Schaus

H. maroniensis Schs. Proc. U. S. Nat. Mus. xxix, 223, 1905.
Figured: Hamps. Suppl. 54: 3; Seitz 57: h6.

Male easily recognized by the enormous antennæ; female almost exactly like *H. thyophora*, perhaps separable by the stronger spots on the legs. The fore legs have two subapical spots, often enclosing a paler spot, and more or less traces of basal ones, the mid-legs with 2 or 3 small brown spots, the hind legs with one. This will distinguish the species from most of the similar ones.

Flight scattering (see diagram, p. 163). Lancetilla, Honduras, Apr. (Bts.). Guiana and Amazons, the southern range uncertain through confusion with *H. thyophora*.

1493 Halysidota sobrina Möschler

H. sobrina Msch. Verh. z.-b. Ges. Wien xxvii, 668, 9: 32, 1877.
Also *figured:* Seitz 57: h7; Hamps. fig. 91.

Female similar to male, but without the sex-scaling. Each tibia with median and terminal black spots.

Chief flight at end of Jan. (see diagram). Lancetilla, Honduras (Bts.) to Bolivia.

1496 Halysidota interlineata Walker

H. interlineata Wlk. List Lep. Ins. Br. Mus. iii, 739, 1855.
H. i. intensa Roth. Nov. Zoöl. xvi, 283, 1909.
Figured: Nov. Zoöl. xvii, 11: 19 ♂, 20 ♀ (*interlineata*), 21, 22 (*intensa*); Seitz 59: e1 (*interlineata*), 2 (*intensa*).

Subterminal band absent, except at the margins (typical) or present, but without spots in cells R_4 and Cu_1 (*intensa*). In the closely related *H. underwoodi* the band is complete.

Feb. (Bts. — typical), June (Fried. — *intensa*). Mexico to Bolivia.

1500c Halysidota grandis Rothschild

H. grandis, Roth., Nov. Zoöl. xvi, 275, 1909.
Figured: Hamps. Suppl. 54: 13; Seitz 57: i3.

Probably a form of *H. cyclozonata*, also described from the Amazon basin. Fore wing with M_3 and Cu_1 strongly divergent; hind wing with Cu_1 practically from angle of cell, M_2 and M_3 stalked. In Hampson's key this species would run to *Hyperthæma*, and the brilliant coloring suggests there may really be a connection. The females average less red than the males.

Principal flight in Dec. (see diagram, p. 163). Lancetilla, Honduras (Bts.) to Brazil.

1506d Halysidota angulata Rothschild

H. angulata Roth., Nov. Zoöl. xvii, 65, 1910.
Figured: Hamps. Suppl. 54: 21; Seitz 58: a5.

Straw color, the fore wing with light brown lunules almost reduced to flecks, a brown spot in cell near end, and a dark streak from lower angle of cell to apex, most distinct toward apex. Legs pale, with a little infuscation of fore tibia and tips of tarsi only.

Nov. 26 (Bts.) July-Aug. (Fairchild, a doubtful female). Described from Peru.

Halysidota tabernilla Schaus

H. tabernilla Schs. Ann. Mag. Nat. Hist. (10) xi, 581, 1933.

All the markings are faint except the black discal spot.

Jan. 27, ♀ (Bts.). Male type also from Panama.

1516 Halysidota annulosa Walker

H. annulosa Wlk. List Lep. Ins. Br. Mus. iii, 738, 1855.
Figured: Hamps. 41: 6; Seitz 57: g3.

M_2 and M_3 of hind wing short-stalked. This looks more like Herrich-Schäffer's original figure of *Charidea texta* (Auss. Schm. 281) than

either of the species usually identified as it, but the present name is safer. Larva pale yellow, with head largely black, and the long pencils black (U. S. Nat. Mus.).

Feb. 24, 27 (Fried.), 11 (A.M.N.H.). Mexico to Amazons. There are a few reared specimens from Geo. Franck's stock, labelled "Brownsville, Tex.", but the record should be verified.

1517 Halysidota catenulata Hübner

Hypocrita (glaucopoidis) *catenulata* Hbn. Samml. Exot. Schm. i, 186, 1812.
Also *figured:* Nov. Zoöl. xvii, 13: 18, 30 (as *walkeri* Roth.); Seitz 57: g1, f7 (var. *parva*).

Smaller and brighter than the related species, and usually distinguished at a glance by the two brown antemedial and postmedial bands. Fore legs fuscous, mid-legs heavily shaded with fuscous, but hind legs with a small spot on tibia only.

The commonest local species from Nov. to Feb. (see diagram). Mexico to Venezuela.

Hal. major Roth. is very close and has much the same range; it is slightly larger, paler, and shows a pale discal dot superposed on the dark postmedial band.

1529 Halysidota iridescens Schaus

Munona iridescens Schs. Proc. Zoöl. Soc. 1894, 233.
Figured: Hamps, 41: 9; Seitz 59: h6 (unrecognizable).

Fresh specimens show the veins are light olive. The dark dots in Hampson's figure are doubtless an error of engraving, carefully copied and exaggerated by Seitz.

Nov., Dec., Jan., Feb. (Bts., Fried.). Mexico to So. Brazil.

Perhaps *Munona* can be kept as a subgenus, based on the small short hind wings and aberrant appearance.

(1509) Halysidota strigulosa Walker

H. strigulosa Wlk. List Lep. Ins. Br. Mus. iii, 737, 1855.
H. pseudomanda Roth., Nov. Zoöl. xvii, 65, 14: 2, 1910.

I am not sure of either of these names; the species stands with *rhomboidea* in the Nat. Mus. but is distinct both in the stalking of R_2 and the pattern. Thorax and fore legs solidly pale, without the brown

spots or shades of some other species. Lunulate lines on fore wing very deeply looped, but less than in the true *rhomboidea*.

Nov. 12 (Bts.) two identical males, Feb. 9 (A.M.N.H.). I have the same thing from the Upper Amazon and S. Brazil. *H. strigulosa* was described from Para, *pseudomanda* from Peru.

Purius Walker

Transitional between Halysidota and Calidota. Cu_1 from close to angle of cell, acc. cell present; palpi oblique, shorter than in Calidota.

2024 Purius pilumnia Stoll

Bombyx pilumnia Stoll in Cr. Pap. Exot. iv, 36, 307: D, 1780.
Also *figured:* Hamps. fig. 184; Seitz 53: f4 (hardly recognizable).

Fore wing pearl gray, dotted and spotted with black; abdomen black ringed, typically on a pink ground, but pearl gray in Mexican males. This species also stands in the National Museum under a ms. name of Dyar's.

Nov. 13, Jan. 26, Feb. 2 (Bts.) Mar. 13 (A.M.N.H.). Mexico to Amazons.

Calidota Dyar

Accessory cell present; M_3 in fore wing well separated from Cu_1; palpi with third segment long and porrect. Larva (of the North American *C. strigosa*) with dense feathery hair as in other Phegopterines, but with only scattered long hairs in place of the usual pencils.

2010 Calidota gemma Schaus

Opharus gemma Schs. Proc. Zoöl. Soc. 1894, 230.
Figured: Hamps. 49: 17; Seitz 56: c1.

Light brown, a black dot (♂) or spot (♀) at end of cell of fore wing. Abdomen blackish with broad subdorsal yellow bands, joining over the top of the tail.

July–Aug. (Fairchild). Venezuela and Brazil.

Euchætias group (Milkweed Tussocks). Similar to Halysidota group; the moth with little or no shaggy hair on base of abdomen. The few larvæ known feeding on milky-sap plants, especially Asclepiadaceæ; with dense paired middorsal tufts, converging to the middorsal line, and with or without pencils. Pupæ short and stocky, but not glossy; cocoon less perfect than in Halysidota group.

This group includes the North America Euchætias, Tanada, Pygarctia and Euverna.

Tanada Walker (*Ammalo* in part)

Similar to Ammalo except for the smooth abdomen and simple pale coloring. Larva on Asclepiadaceæ and Apocynaceæ, as a rule.

1339 Tanada insulata Walker

Halesidota insulata Wlk. List Lep. Ins. Br. Mus. iii, 734, 1855.
Ammalo insulata Jord. Nov. Zoöl. xxiii, 124 ff., figs. 1-3, 8 (genitalia).
Figured: Hamps. 37: 14: Seitz 53: g4; Holland, Moth Book 14: 3.
Larva: Swainson, Jour. N. Y. Ent. Soc. viii, 33, 1900; Hamps. Suppl. 195; Seitz p. 384.

Yellow, with black-spotted body. Larva black, with four red-brown segments, and white dorsal spots; hair black. On Jack-in-the-bush (*Cordia cylindristachya* R.S., Boraginaceæ).

Feb. 10 (A.M.N.H.), Apr. 9 (Fried.), July (Fairchild). La Venta, Panama (Jan.). Honduras, Mar., May. Southern U. S. to Brazil, the southern limit uncertain through confusion with *T. aurata* Btl. The latter has the front and more of the palpus blackish.

Metaxanthia Hampson

Wings narrower and more clean-cut than Agoræa; hind wing transparent, contrasting with fore wing.

1. Basal portion of fore wing fully scaled; third segment of abdomen solid black above ..... *aureiventris*
   Fore wing with areas between veins translucent practically to base; third segment of abdomen above mostly (typically wholly) yellow ..... *atribasis*

1532a Metaxanthia aureiventris Rothschild

M. aureiventris Roth., Nov. Zoöl. xx, 591, 1913.
Figured: Hamps. Suppl. 56: 1.

Basal two thirds of fore wing blackish, unlike *M. vespiformis* and *auranticauda;* last half of abdomen orange.

Jan. 5 (Bts.), Mar. 12–18 (A.M.N.H.). Costa Rica and Colombia (type).

1532b Metaxantiia atribasis Rothschild

M. atribasis Roth., Nov. Zoöl. xx, 591, 1913.
Figured: Hamps. Suppl. 56: 2.

The present specimen has some black dorsal scaling on the third segment and may be rather an abnormal specimen of *M. vespiformis*.

July 30, 1924 (Banks) 1 ♀; described from Ecuador.

Agoræa Herrich-Schäffer

Wings both alike and translucent, typically broad; body very small.

1. Antennæ of male broad, wings broad and blunt, body slight; abdomen with a full set of dorsal black dots . . . . . *minuta*
   Antennæ of male narrow, wings more pointed, shaped as in Halysidota; body stouter with black dots on basal segments or none . . . . . *semivitrea*

1536 Agoræa minuta Schaus

A. minuta Schs. Proc. Zoöl. Soc. 1892, 288.
Figured: Biol. 79: 2; Seitz 55: e2.

Head and collar concolorous pearl gray.

Chief flight at end of October (see diagram). Mexico to So. Brazil.

1537 Agoræa semivitrea Rothschild

A. pellucida Hamps. Cat. Lep. Phal. iii, 175, fig. 97, 1901 (not Sepp).
A. semivitrea Roth. Nov. Zoöl. xvi, 291, 1909.
Also *figured:* Hamps. Suppl. 56: 9; Seitz 55: e8.

The fork of Cu is emphasized with blackish, and also a spot at lower angle of cell.

Chief flight in Dec. (see diagram, p. 163). Mexico to Brazil.

Bituryx Walker

Like Agoræa, except for the shorter palpi. The present species lies between the two Agoræas in appearance.

The following species belongs to a small group (Hampson's Sect. I) with a woolly tuft on end of female abdomen and whitish wings with dark veins. Besides the following and *B. intacta* and *venosata* there is an undescribed species from Texas.

Sepp. figures the larva of *B. pellucida*. It is rather sparsely hairy, with a pair of pencils near anterior end, the body striped, and marked with blue and a little red dorsally. It eats Costus (Scitaminaceae).

Biturix pervenosa new species

Probably *B. venosata* auct. in part (Panama material).

Head, including base of antennæ and palpi, neck, collar, shoulders and fore coxæ bright yellow. Body pearl gray, a middorsal stripe and disc of tegulæ darker; abdomen yellow, with dorsal black dots in male and lateral ones in both sexes; the lateral series starting with the second segment; hoods pearl gray. Under side whitish, the sides and end of the female anal tuft mouse gray, except middorsally, the lower part cream white. Wings shading from white to pearl gray, with conspicuous dark gray veins, heavier than in the other species, especially on the hind wing. Fore wing shading to a strong gray toward margin. The hind wing is pure white except for the veins and broad gray anal area. ♂ 27, ♀ 35 mm.

Barro Colorado Id., C.Z., Panama (Bates), holotype male and 10 male and 2 female paratypes. Late Oct.-late Jan., May 12 (see diagram, p. 163). Cano Saddle, C.Z., May (Shannon) ♂ paratype in U. S. National Museum (type No. 51596).

The palpi are longer than in *B. venosata* and the Texas species, extending obliquely about to level of middle of front; *venosata* also has much darker wings, especially the male hind wings, and *intacta* should lack the gray veins on the hind wing. There are further undescribed species in South America.

Tribe BELEMNIINI (new)

Eyes small, ocelli distant from them, the head with a broad lateral scaled stripe behind them; front bowed out, the palpi barely exceeding it, but tongue strong; abdomen close-scaled; fore wing partly metallic; mid and hind tibiæ with fine spinules beneath; Sc of hind wing not reaching margin. Early stages unknown.

This is a distinct little group, intermediate between the Phegopterini and Euchromiidæ; and perhaps should be transferred to the latter. The spined tibiæ and peculiar head will distinguish it in either family. The three genera are very close, only differing in M_2 and M_3 of the hind wing.

Belemnia Walker

Hind wing with M_2 and M_3 completely united.

Belemnia pavonia new species

Black, marked with metallic blue-green. Head with patches on sides of palpi, most of front, dots on vertex and occiput; whole sides behind eyes; thorax with large patches on sides, lateral ends of collar, fore pleuræ, a pair of spots anteriorly on disc, metascuta and center lobe of metascutellum blue; abdomen with lateral bars in front, becoming spots behind, but no dorsal blue; also sublateral blue spots on segments 2 and 3; venter scarlet on middle of 3 and whole of 4–8. Legs spotted and streaked with blue. Whole ground of body iridescent with deep pure green, strongest on middorsum of first segment of abdomen. Fore wing evenly dusted with green, leaving the apex and outer margin black; with blue at base; hind wing dead black, with a large blue basal patch, extending somewhat on cell, and in a point below fold. Under side black, fore wing with a blue patch over cell and above fold to 1/3, an irregular bar over end of cell, and a diffuse green shade on pm. region; hind wing with the basal blue shorter, but extending from costa to below fold, and two separate dots at angles of cell. Fringes white.

This species resembles *Diospage engelkei*, but has less bright blue on thorax and more postmedially on under side, besides the different venation; it is closest to *B. alpha*, but instantly separable by the scarlet under side, and lack of white apices of the wings.

Barro Colorado Id., Feb. 7 (Bates); 1 ♂.

Diospage Walker

Hind wing with M_2 and M_3 stalked about half way to margin.

1. Red band of fore wing beneath cut off at Cu_1; veins across red patches above and fringe of hind wing scarlet; green base of fore wing cut off squarely..... *chrysobasis*

   Red band of fore wing beneath curving and extended to A; veins across red patches and fringe of hind wing black, contrasting; basal green of fore wing gradually tapering off, and extending much further below costa..... *splendens*

1618 Diospage splendens Druce

Belemnia splendens Dr. Ann. Mag. Nat. Hist. (6) xv, 44, 1895.
Figured: Hamps. 43: 10; Seitz 42: d5.

Typically there is a crimson spot on middle of fore wing which is lacking in these two specimens.

Nov. 26 (Bts.). Peru and Bolivia.

1619 Diospage chrysobasis Hampson

D. chrysobasis Hmps. Cat. Lep. Phal. iii, 212, 43: 13, 1901.
Also *figured:* Seitz 42: d6.

Feb. 4 (Bts.) May 3 (Fried.). Described from Colombia.

Belemniastis Hampson

M_2 and M_3 of hind wing merely connate. Fore wing rather more ample.

1623 Belemniastis trotschi Druce

Belemnia trotschi Dr. Ann. Mag. Nat. Hist. (6) xviii, 37, 1896.
Figured: Biol. 72: 25, 27; Hamps. fig. 122; Seitz 42: e3 (band of fore wing scarlet, in error).

The band of the fore wing is orange, and much wider than in the preceding species.

May 5 (Fried.). Described from Costa Rica.

Tribe ARCTIINI

Larva with numerous more or less equal tufts of barbed hair, representing all the ordinary tubercles; the longer hair when present scattered, not forming pencils or special tufts; pupa with flange-plates in front of spiracles of abdominal segments 4–6; tongue shorter than wing-cases. Imago with tongue always short or rudimentary; palpi usually barely exceeding front; hind wing with Sc complete, normal.

This is a typically Old-World group, and also strongly represented in the Nearctic, mostly by Old-World genera, but is very weakly represented in the Neotropical. Only the Eubaphe group is American, and best developed in the tropics.

Eubaphe Group: R_5 stalked beyond R_3, typically united with R_4; hind wing with one medial lost; palpi beaklike, the second segment curved down, and third long and porrect.

Virbia Walker

R_4 and R_5 stalked. Closely related to the Nearctic genus Eubaphe and perhaps the Neotropical Brycea, but without other close kin.

1. Patch on hind wing widening strongly to costa, especially below; neck red ..... *orola*
   Patch on hind wing covering outer half except border, or more extended; neck not red 2
2. Hind wing with an orange patch on outer half ..... *fluminea*
   Orange area of hind wing reaching base 3
3. Base of costa of hind wing below yellow ..... *rosenbergi*
   Costal stripe of hind wing below reaching base ..... *underwoodi*

1596d Virbia rosenbergi Rothschild

V. rosenbergi Roth., Nov. Zoöl. xvii, 77, 1910.
Figured: Hamps. 56: 24; Seitz 38: d6 ♂, 7 ♀ (as *medarda*).
V. medarda auct. in part, not Stoll.

Fore wing with more or less overscaling, varying from blackish to dull olive in color effect. Under side with orange on disc very variable, but always with a little along base of Cu. Border of hind wing extremely variable, but never extended toward base in a sharp wedge on fold, in some females extended as a broad area; beneath with yellow abruptly extended across costal area at base. The female is much larger, and averages darker than the male.

Abundant (see diagram, p. 163). Reported by Hampson from Mexico to Ecuador. Replaced in northern South America by the true *medarda* (♀ *mentiens* Wlk.) with the black border of hind wing extended in, in a sharp point on fold.

1593a Virbia orola Dyar

V. orola Dy. Proc. U. S. Nat. Mus. xlvii, 173, 1914.

July–Aug. (Fairchild, Nat. Mus.). Described from the Canal Zone.

1596e Virbia underwoodi Druce

V. underwoodi Dr. Ann. Mag. Nat. Hist. (8) viii, 140, 1911.
Figured: Hamps. Suppl. 56: 25 ♀.

If I have the male of this species correctly identified, it is smaller and blunter winged than *V. rosenbergi*, with very heavy black border of hind wing.

Mar. 17 (A.M.N.H.). There is a similar ♂ from Colombia in the Cornell collection, and females resembling the figure have been examined from Lancetilla, Honduras (Bts.), Costa Rica and Colombia.

1598c Virbia fluminea Schaus

V. fluminea Schs. Ann. Mag. Nat. Hist. (8) ix, 39, 1912.
Figured: Hamps. Suppl. 57: 5.

Nov. 2, 9, 15, Jan. 28 (Bts.), Feb. 17 (A.M.N.H.). Described from Costa Rica.

Arctia Group: Palpi short as well as tongue; base of abdomen frequently shaggy; fore wing with R_3 and R_4 stalked beyond origin of R_5, or stalked from accessory cell.

Ecpantheria Hübner

The largest of American Arctiids. Essentially tropical but with one species extending well into the Nearctic. The larvæ are black and dull red, with rather equal tufts of very stiff black hair. I have revised the genus (Ann. Ent. Soc. Am. xxii, 310–330, 1929, xxvi, 560–562, 1933).

1. Fore wing black spotted.....*læta*
   Fore wing marked with dark rings, or immaculate.....2
2. Males (hind wing lobed, frenulum simple).....3
   Females (hind wing not lobed; frenulum triple).....4
3. Antenna serrate; no hair pencil on lobe of hind wing beneath; ocellate spots normal when traceable.....*icasia*
   Antenna simple; a hair pencil on lobe of hind wing beneath; ocelli about end of cell contrastingly dark, frequently black.....*orsa*
4. Abdomen orange, with white subdorsal bars.....*icasia*
   Abdomen blackish or with heavy blue spots.....*orsa*

1909 Ecpantheria læta Walker

E. læta Wlk. List Lep. Ins. Br. Mus. iii, 696, 1855.
E. læta Forbes, Ann. Ent. Soc. Am. xxii, 329, 1929.
Figured: Seitz 40: e2 ♂.

Hind wing of male with a very large lobe, but without pencil; the wing yellow with a black patch on lobe.

Feb. 8, 14 (A.M.N.H.), Mar. 1–8, Apr. 7, 28, May 24, June 18 (Bts. & Fried.). Ranges south to Brazil.

1929 Ecpantheria icasia trinitatis Rothschild

E. trinitatis Roth., Nov. Zoöl. xvii, 173, 1910.
E. i. trinitatis Hamps. Suppl. 453, Forbes, Ann. Ent. Soc. Am. xxii, 319, 328, 1929.
I know of no figure of this form. Form *yukatanensis* is figured by Obt. Études Ent. vi, 13: 4.

The entire series from Barro Colorado Id. are an albinic race, with the black markings practically lost, and the white on the abdomen showing a strong tendency to make transverse stripes across the segments. The male can be separated from *E. eridanus* Cr. by the much narrower antenna, but some of these females may be indistinguishable. In the specimens that show traces of ocelli they are normally large, in *eridanus* minute (see Hübner, Samml. i, 191).

Dates scattering (see diagram, p. 163). This race covers southern Central America and northern South America to Peru, except a limited area in Colombia.

1927, 1925, 1919 (part) Ecpantheria orsa Cramer

Bombyx orsa Cr. Pap. Exot. ii, 75, 143: F, 1777.
Bombyx cunigunda Stoll, in Cr. Pap. Exot. iv, 104, 344: D, E, 1781.
Ecpantheria orsa Forbes, Ann. Ent. Soc. Am. xxii, 323, 329, 1929.
Also *figured:* Oberthur, Études Ent. vi, 14: 1, 2, 3, 5, 6, 15: 6 (various forms); Hamps. Suppl. 63: 3 (var. *perplexa*); Seitz 40: h2, i1, i5, 67: e6 (various forms).

The species divides up into a number of ill-defined races, and varies individually. For an analysis see my paper, cited. The Barro Colorado form is reasonably typical.

Nov. 28, Dec., Mar. (Bts.). Type form from Northern South America, races in Central America and southward.

Apantesis Walker

An essentially North American genus, normally with fore wing blackish, cut up by pale vein-streaks and lines, and bright red or yellow, black spotted hind wing.

1958 Apantesis proxima Guérin

Chelonia proxima Guér. Icon. Règne Anim, iii, 514, 1844.
Arctia mexicana Grt. & Rob. Ann. Lyc. N. Y. viii, 367, 13: 3, 1867.

Also *figured:* Stretch, Zygænidæ & Bombycidæ 9: 4 (*arizonensis*); Holland, Moth Book 16: 32 (♂ as *autholea*), 15: 4 ♀; Seitz 39: b2 ♂, 3 ♀.

Hind wing of male white, of female red and black.

Feb. 17 (A.M.N.H.). Ranges to western U. S.

Tribe UTETHEISINI

Larva with simple stiff bristles, mostly single; skin brilliantly colored; pupa brilliantly colored, with cremaster but without flanges, in a very flimsy cocoon.

This is an Old World group save for two species, one limited to the Galapagos. *Utetheisa ornatrix* L. is reported by Dyar from the Canal Zone, and will certainly be found on the Island if there is a patch of *Crotalaria* anywhere.

PERICOPIDÆ

Separable from the preceding groups by the shorter fusion of Sc and R of the hind wing near base, the veins being united for 1/5 the length of the cell or less, sometimes very shortly. This character is shared by the Noctuidæ, but the few types of the latter which have a large tympanic hood above the spiracle are small and obscure (*Herminiinæ*), while all of the present family are showy. Larvæ exactly as in the Arctiinæ, except that wart iv of 7th abdominal segment is markedly lower than on the segments preceding and following. The proleg hooks are abruptly shorter at the ends of the rows (heteroideous).

This family is very close to the Old World Hypsidæ, and is not always separated. Both are treated as mere subfamilies of the Arctiidæ in Seitz. In the typical Hypsidæ Sc and R are not fused at all, but connected by a cross-vein. Nyctemera has a short fusion like Pericopidæ. The larvæ of the *Hypsa* group feed on Ficus, of *Nyctemera* and *Tyria* on Senecio, like *Pericopis sacrifica*.

1. Hind tibia with both pairs of spurs; fore wing with R_2 shortly stalked on R_{3-5} ..... *Eucyane*

   Hind tibia with end spurs only.

2. Fore wing with R_2 from accessory cell or occasionally free. *Pericopis*

   R_2 stalked with R_{3+4} beyond the origin of R_5 ..... *Hyalurga*

Eucyane Hübner (with *Esthema* Hübner)

Black with strong blue iridescence. In the typical group there is a white, red or yellow transverse band; the following species belongs to group *Esthema*, with white streaks between the veins.

Eucyane aletta Stoll

Phalæna aletta Stoll in Cr. Pap. Exot. iv, 221, 396: C, 1782.
Also *figured:* Preiss, Abbild. Nachtschm. 10: 1; Seitz 61: c1.

The white markings are a single series of spots between the veins toward margins, becoming streaks toward inner margin of hind wing. The spot in M_3 is markedly the shortest.

July-Aug. (Fairchild), Dec. 24 (Bts.). Guatemala to Ecuador and Guiana.

Pericopis Hübner

Striking moths of very varied pattern, the female frequently very unlike the male and mimicking Lycorea, the first genera of Ithomiinæ, or even the Aristolochia Papilios. The Pericopids are of rubbery texture, and the mimicry is undoubtedly Müllerian.

The larvæ have regular tufts with a few longer hairs, and are brilliantly colored (see Seitz under *P. leucophœa, lycaste* and *sacrifica*).

1. Collar with two yellow spots on each lobe, sometimes fused into a large yellow patch. 2
   Collar black, without yellow spots; the thorax behind collar sometimes with large yellow spots. 4
2. Yellow spots on collar small, similar to spots on head and somewhat larger ones on disc of thorax. Fore wing with base heavily black-marked on an orange ground, or if solid blackish with the outer boundary irregular. . . . . *angulosa*
   Yellow spots on collar large, almost or quite joining; basal part of fore wing varying from yellowish gray to dirty pale orange, not black or bright orange marked with black. 3
3. Hind wing yellow, the border solid black or marked with a red anal spot. . . . . *tricolora* ♂
   Hind wing evenly orange, with a white-spotted black border. *molesta*

4. Base of fore wing blackish out to an oblique line; shoulders with large yellow spots; hind wing yellow (♂) or orange (♀) with broad white-spotted black border.....*marginalis*
Thorax and most of fore wing solid blackish; hind wing black, with a pink anal patch.....*tricolora* ♀

Pericopis tricolora jansonis Butler

[*Phalæna Noctua tricolora* Sulz. Gesch. Ins. 160, 22: 1776; Cramer, Pap. Exot. iii, 125, 263: E, 1779.]
[*Phalæna aglaura* Cr. Pap. Exot. iii, 126, 263; F, 1779.]
P. jansonis Btl. Lep. Exot. 46, 17: 4, 5 ♀, 1870.
Also *figured:* Biol. 11: 10 ♂ (*jansoni*).

In the Panama and Colombia race *jansonis* the male usually has a red anal patch, and in the female the red patch is rounded, and unbroken, unless there is a small separate spot above Cu_2.

Dec. 30 (Bts.) ♀. Busck also took the male in the Zone. The species ranges south to southern Brazil.

Pericopis marginalis panamensis Hering

[*Daritis marginalis* Wlk. List Lep. Ins. Br. Mus. iii, 618, 1855. ♀]
[*Pericopis dissimulans* Wlk. List Lep. Ins. Br. Mus. xxxi, 155, 1864 ♂.]
P. m. panamensis Hrg. Macrolep. World vi, 442, 1925.
Races of *marginalis* are figured in Seitz 63: d1, 2 (*crassifascia*) and f1 (*magdala*).

In the Panama race the male has the irregular patch beyond the cell considerably scaled with white, and the veins all around the cell are finely blackish; the female has the black postmedial line fine, and typically fading out before the anal angle; in *P.m. magdala* the veins behind the cell of the male are whitish or partly red. Southern races have the postmedial part of the fore wing more transparent in the male, and the postmedial line of the female hind wing heavy toward the anal angle.

Nov., Jan., May, July-Aug. Race *panamensis* was described from Chiriqui; races range from Guatemala to Bolivia.

Pericopis molesta Hering

P. molesta Hrg. Macrolep. World vi, 443, 63: g4 ♂, 1925.
? *P. umbra* Druce, Biol. Centr. Am. Het. i, 113, 12: 2, 1885 ♀.

The Barro Colorado Id. specimens are smaller than Hering's figure, but agree in pattern. I strongly suspect this is merely the ♂ of

P. umbra, described from Salvador. The latter has the same body and fore wing pattern, but the hind wing has a black postmedial band, extending out and in on the veins. The hind wing is orange, even in the male.

Nov.-Dec. (Bts.). Popayan, Col. (type).

Dyar also reports *P. angulosa irenides* Btl. from the Zone. It resembles normal *angulosa* (Seitz 62: b2), but the postmedial band is all yellow; and the base much darker, sometimes wholly black.

Hyalurga Hübner (with *Lauron* Walker)

In most species the pattern is similar, a paler ground with black borders, more or less overlaid with orange, and generally a fascia across the end of the cell. The pattern varies some, and the body-patterns seem to give the best specific characters.

The larva of *H. vinosa* (the Antillean species) is yellow, variegated with wine color, with segments A1, 2, 7, 8 dark; the warts mostly blue. The hair is rather sparse, i and iv having single hairs. It feeds on *Tournefortia* and heliotrope.

1. Smaller species; lower discocellular of hind wing longer; sides of thorax largely orange (*Lauron*).....2
   Larger species; lower discocellular of hind wing very short; sides of thorax white or with a black stripe only (*Hyalurga*).....3
2. Propleura also orange; 1st A and veins of hind wing black in both sexes; some orange in postmedial fascia before the subapical white patch.....*soroides*
   Propleura black and white; 1st A and veins of hind wing white in male; no orange in postmedial fascia.....*leucophœa*
3. Subdorsal stripes of abdomen solid orange, except on first and last segments.....*fenestra*
   Subdorsal stripes mostly white or light gray, but with addorsal yellow spots on second segment.....*albovitrea*

Hyalurga fenestra Linnæus

Phalæna Bombyx fenestra Linn. Syst. Nat. (Ed. 10) i, 505, 1758; Mus. Lud. Ulr. 372, 1764, Clerck, Icones 55: 41; 1764.

Sphinx adscita egeon Cramer, Pap. Exot. i, 91, 59: B, 1775.

Also *figured:* Seitz 65: a1 (Panama race).

The thorax has a black line below the wings. Typically the hind wing has well separated marginal and submarginal black lines (as

figured by Cramer), in Panama specimens these are largely fused into a broad black border.

Mar. 29, 31 (Fried.) 2 ♀. Ranges to So. Brazil.

Hyalurga albovitrea subnormalis Dyar

[*H. albovitrea* Wlk. List Lep. Ins. Br. Mus. xxxi, 153, 1864.]
[*H. irregularis* Fld. Reise Novara Lep. 103: 16, ♂, 1874.]
H. subnormalis Dyar, Proc. U. S. Nat. Mus. xlvii, 174, 1914.
Figured: Seitz 65: d1 ♂ (Also c4 ♀ of *albovitrea*).

Strongly sexually dimorphic. Male ground white, the most conspicuous mark a gray spot at end of cell; female gray with white postmedial spot on fore wing and bar along cell of hind wing. The typical (South American) male has a black border on the hind wing, and yellow marginal spots in cell Cu_1 of both wings, lacking in the Panamanian males. I see no difference in the females.

Feb. 3, fresh ♂ (Bts.), May 1, rubbed ♀ (Fried.). *Subnormalis* was described from the Canal Zone, typical *albovitrea* from the Amazon.

Group *vinosa*

I am now inclined to believe there are about three species of this group, differing in the distribution of orange on the thorax. Typical *vinosa*, with the thorax dominantly orange, is practically limited to the Antilles, unless *H. chthonophyle*, from Mexico is a race of it. The two mainland stocks differ in the color of the side of the prothorax, and perhaps in details of fore wing pattern in any one locality, but the latter varies so much racially that forms cannot be placed until types are examined. The color of the prothorax is never mentioned in descriptions or shown in figures, so the use of names is uncertain. I suspect one of the two following is the true *sora* of Boisduval (Lep. Guat. 79). But only the type will decide which.

Hyalurga leucophæa leucophlebia Hering

[*Dioptis* (*Lauron*) *leucophæa* Wlk. List. Lep. Ins. Br. Mus. ii, 334, 1854.]
Hyalurga leucophlebia Hering, Macrolep. World vi, 450, 65: e2 ♂, 3 ♀, 1925.

Translucent with black border and veins, and apical third of fore wing, the latter containing an elliptical white fascia. Orange stripes on basal half of costa, inner margin, lower part of outer margin and border

of hind wing, but none before the postmedial fascia. Female larger and darker than male, the black veins heavy and the translucent portions much darkened by fine black scales.

Oct. 29, Dec. 25, Jan. 31 (Bts.) all females; Dec. 25 (Am. Mus. Nat. Hist.) ♂. Amazon tributaries, Venezuela, E. Peru (Cornell). Distribution uncertain through confusion with the following.

Hyalurga soroides Hering

H. soroides Hrg. Seitz Macrolep. World vi, 450, 65: e5 ♂, 6 ♀, 1925.
Laurona rica Dr. Biol. Centr. Am. Het. i, 156 (not Hübner).

Identical with the preceding except as noted in the key. I suspect an older name for this, perhaps *sora*, under which it stands in the U. S. Nat. Mus.

June 24 ♂ (Fried.), July-Aug. ♀ (Fairchild), Apr. 2 ♂ (Bradley-C.U.). "Mexico to Colombia" (Hering).

B. *Agaristidæ, Lymantriidæ, Notodontidæ, Dioptidæ*

This second installment completes the types with thoracic tympanum, except for the very large family Noctuidæ. The material is as before, except for the addition of a lot collected by an American Museum Expedition composed of F. E. Lutz, W. J. Gertsch, and Wm. C. Wood in February and March, 1936. Unfortunately the Fairchild material is very scant in these families, so that summer is almost a blank. Collecting at that time will certainly add several more species, though the Notodontidæ, the principal family of this installment, have wide ranges and long flight periods.

Of the four families now discussed, the Agaristidae are a mere offshoot of the Noctuidæ, being directly connected to the Eudryas-Erocha group of the Acronyctinæ, and like them feed chiefly on Vitaceæ. The Lymantriidæ are a degenerate offshoot from the ancestors of the five preceding families; while the Notodontidæ and Dioptidæ are very closely related to each other, and probably ancestral, having a trifid venation, and a more primitive condition of the tympanum, but agreeing in the essential features of tympanum, egg and larva. The Dioptidæ are a minor offshoot of the Notodontidæ, and should be probably relegated to a subfamily, but they differ widely in appearance, being slender and brilliantly marked, and in habits, being generally active day-fliers. They are also strictly Neotropical

(save for one species in western U. S.), while the other three families are world-wide (save that the Agaristidæ miss Europe).

The following are the principal works on the area, so far as concerns these families.

Druce: Biologia Centrali-Americana, Lepidoptera Heterocera, 2 vols. text and 1 of plates (abbreviated in the citations of figures as "Biol." with plate and figure numbers).

Hampson, G. F.: Catalogue of the Lepidoptera Phalænæ, iii and supplement ii (Agaristidæ).

Prout, L. B.: A Provisional Arrangement of the Dioptidæ, Nov. Zoöl. xxv, 395–429, 1918.

Seitz, A.: Macrolepidoptera of the World *or* Grosschmetterlinge der Erde; vi, Lymantriidæ by Schaus, Dioptidæ by Hering, Notodontidæ by Draudt; vol. vii, Agaristidæ by Draudt. (abbreviated "Seitz" with plate, line, and figure counting from the left).

Bryk, F. (Editor): Lepidopterorum Catalogus. Part v, Agaristidæ by Strand, 1912; lxii, Lymantriidæ by Bryk, 1934; lix, Notodontidæ by Gæde, 1934; xlii, Dioptidæ by Bryk, 1930.

Dyar, H. G.: Proc. U. S. National Museum xlvii, 139, 1914 (giving further Canal Zone data for many species).

Schaus, William; A revision of the Notodontidæ, Trans. Ent. Soc. London, 1901, 257, ff. (with index on pp. lxx-lxxii).

Schaus, William: New Moths of the Family Ceruridæ, Proc. U. S. Nat. Mus. lxxiii (19,) 1928.

In these families Hampson fails us (save for two Agaristids) and Seitz contains a larger number of new figures, but the delicate shadings and patterns have proved too difficult for the artist (or for the process) and many are unrecognizable. Hering's treatment of the Dioptidæ can fairly be called a revision, especially as supplemented by Prout's generic analysis and catalogue (Nov. Zool. xxv, 395, ff. 191); but the Lymantriidæ and Notodontidæ need major revision from the world point of view; our present classifications are artificial, and even inconsistent from fauna to fauna.

Dates are presented as in the previous installment.

AGARISTIDÆ

Head with strong palpi and tongue, the front heavily chitinized and modified, antennæ simple, distinctly swollen toward their tips (unlike the Noctuidæ); tympanum of Noctuid type, with a very large resonating cavity in the dorsum of the first abdominal segment, facing the counter-tympanic membrane. Venation as in the Acronyctinæ, with Cu quadrifid in fore wing, trifid in hind wing (M_2 obsolescent), Sc and R touching at basal quarter of cell, connected by an extremely short cross vein or barely fused. Larva with simple hair, usually humped on 8th abdominal segment, brilliantly marked with black, white and orange; feeding on Vitaceæ and occasionally Onagraceæ. Pupa rugose, with minute single setæ, those of the cremaster minute; cremaster broad, flat and thin.

The two regional species belong to a primitive American group very close to Eudryas in the Acronyctinæ.

1. Acc. cell with R_2 stalked from its tip in both sexes; M_1 from its posterior side. . . . . *Euschirropterus*
   Acc. cell normal, with R_2 separate from before its tip (unless obliterated by the very large stridulating organ); M_1 free in both sexes. . . . . *Darceta*

Darceta Herrich-Schaeffer (*Diamuna* Walker)

Front with a truncate conical prominence; antennæ slender; abdomen without dorsal tufts; eyes very large.

Darceta falcata Druce

Hecatesia falcata Dr., Biol. Centr.-Am. Lep. Het. i, 35, 5: 23 ♂, 24 ♀, 1883.
Diamuna falcata Hmps. Cat. Lep. Phal. iii, 651, fig. 286, 1901.
Darceta falcata Strand, Lep. Cat. v, 38, 1912.
Also *figured:* Seitz vii, 1: b9.

Brown, fore wing in male with a large bulla and modified venation, doubtless for stridulation, the female normal. Hind wing yellow with black border, in northern specimens nearly limited to the outer margin, in the southern race *hesperina* H.-S., from Santa Catherina, extending along inner margin nearly to base. A specimen in the Nat. Mus. from Peru is transitional.

Jan.-June (see diagram). All the 16 specimens seen from B.C.Id. are females. Described from Panama.

Dyar also describes *Euschirrhopteryx pocyi pulverosa* from the Canal Zone. The male is nearly transparent, with somewhat modified venation, the female fully scaled with the costal half of fore wing contrastingly paler than the dorsum.

LYMANTRIIDÆ

(*Liparidæ*)

Ocelli and tongue absent; palpi frequently reduced; antennæ very broadly pectinate in both sexes, usually pectinate to the tip in male, and with the shaft bowed. Legs generally heavily tufted, the fore tarsi also with heavy tufts and displayed at rest. Fore wing as in related families, the accessory cell frequently broad, and R_1 arched in such a way as almost to enclose a second acc. cell. Hind wing with Sc and R touching, connected, or very slightly anastomosed about middle of length of cell; Cu quadrifid in both wings, but generally with a rather distinct transverse vein (ldcv) between origins of M_2 and M_3. Tympanum of the true Noctuid type, the membrane vertical; frequently with hood above spiracle on first segment of abdomen.

There have been attempts to divide the family on the presence or absence of the acc. cell, or the curvature of the base of R_2, whether or not it encloses a true acc. cell, but these systems separate very closely allied forms. A more natural division is on the basis of the larva, which is of three types: 1, with sparse irregularly tufted hair, poison spinules and brilliantly marked body (the Brown-tail type); 2, with regular and subequal tufts, the lateral ones longer, at least on prothorax (the Gypsy type) and 3, with massive dorsal tufts on about 4 middle segments and slender pencils at ends of body (the Tussock type). The primitive African Lymantriidæ seem to be related to the first type; of the present genera, Thagona and Caviria belong with the brown-tail; Sarsina and Stætherinia to the Gypsy type, while Desmoloma is an isolated genus with unknown larva, and may not be a true Lymantriid.

Larva of the present genera (Lymantriinæ) with tufted hair from warts, three subdorsal warts each on meso- and metathorax; and two (in the Satin-Moth 3) small middorsal eversible glands on posterior

segments. Pupa densely hairy, in a slight cocoon, partly formed of the larval hair; tongue short, leaving the palpi uncovered.

1. Fore wing with acc. cell, formed between R_{2+3} and R_{4+5}, R_1 free or from its base; hind tibia with end spurs only; white moths. *Caviria*

   Fore wing without accessory cell, R_1 sometimes sinuous in such a way as almost to form an acc. cell *above* R_2.....2
2. Hind tibia with both pairs of spurs; fore wing as a rule with colored wings and full pattern.....3

   Hind tibiæ with end spurs only; fore wing with R_1 usually sinuous, R_2 stalked, or rarely connate..... *Thagona*
3. Fore wing with R_2 stalked, R_{4+5} free from R_{2+3}, the costal venation crowded; male hind wing with lobed costa..... *Desmoloma*

   Fore wing with all radials distinct; R_1 and R_2 free, R_{3-5} stalked..4
4. R_5 barely stalked; apex squarish..... *Sarsina*

   R_5 decidedly stalked; apex subfalcate..... *Stætherinia*

Caviria Walker

Palpi just exceeding front, the joints well set off; fore tibiæ with moderate tuft, the tarsi with a little loose hair; fore wing with R_1 typically free from R_2, anastomosing with Sc but individually variable; hind wing with R and M_1 free; M_3 and Cu_1 widely separated.

Larva (of *C. comes* Geyer, Jörgensen, Rev. Soc. Ent. Argent. ii, 32). Slender, dark green, the hair long and sparse, pale gray with some black; body with yellow dorsal line, and reddish spots on one anterior and 2 posterior segments. Head, etc., greenish yellow. The larva is lively. Pupa in a slight web; green with white hair, yellow dots and a pair of white spots on second segment.

Caviria vinasia Schaus (Fig. 66)

C. vinasia Schs. in Seitz Macrolep. World vi, 544, 74: b4 ♂, 3 ♀, 1927. Also *figured:* Biol. 15: 1 (as *substrigosa*).

Silky white, the fore wing with three bands of watering, whose position varies with the lighting, the two outer slightly sinuous, but not in corresponding waves. Palpi white; fore tibiæ shaded with gray.

Common (see diagram, p. 245). Costa Rica (type). Probably examination of genitalia will be needed to understand this group in South America. The National Museum has similar specimens (with white palpi) from Northwestern South America under the name of *regina*.

Thagona Möschler

Fore tibia with a moderate tuft and metatarsus with a smaller one, or both (♀) with loose hair. R_1 sinuous and R_2 stalked (least in *T. tibialis*).

1. Fore wing heavily marked with light brown.....*taus*
   Fore wing white.....2
2. Fore wing thickly scaled, usually with a few black dots. . .*tibialis*
   Fore wing translucent, with two fine oblique parallel light brown lines.....*pura*

Thagona taus Dyar

Caviria taus Dyar, Proc. Ent. Soc. Wash. xii, 85, 1910.
Figured: Seitz 72: k6 ♂.

Mixed white and light brown; a fine brown line in base of cell and black dash in middle of fold; base white toward inner margin only.

Feb. 12 (A.M.N.H.) 1 bad ♀, apparently of this species. Described from Guiana.

Thagona pura Walker

Stilpnotia (?) *pura* Wlk. List Lep. Ins. Br. Mus. vii, 1732, 1856.
Figured: Seitz 72: k3.

Feb. 28, Mar. 2, 4, Apr. 26 (Fried.) all females. Ranges to the Amazons and Costa Rica. The male has much shorter wings.

Thagona tibialis Walker

Stilpnotia (?) *tibialis* Wlk. List Lep. Ins. Br. Mus. iv, 842, 1855.
Figured: Seitz 73: i6 ♂, 5 ♀.
Larva: Jörgensen, Rev. Soc. Ent. Argent. ii, 32, 1928; Iris xlvi, 41, 55, 1932.

White, with a maximum of four black dots, two in end of cell, one just beyond and a postmedial one in cell M_2, the dots often reduced or lost. Sides of palpi and back of head black; black stripes on fore tibia and all tarsi of female only.

Larva bluish white; a hump on segments 8–10 with yellow, confluent black-bordered patches, a black lateral line and yellow subventral spots; hair mostly white, a few black; head blackish, with white front etc. A general feeder. Pupa green with black pattern and white hair.

Oct. 6, Dec. 4, 6, Feb. 3. Mexico to Argentina.

Sarsina Walker

The three following genera agree in having colored wings, palpi extending beak-like well beyond the front; and the known larvæ are flattened with enlarged lateral warts, much like the Lasiocampidæ but more lively.

Sarsina is light pinkish brown, marked with darker brown with a slight olive tint; ante- and postmedial and subterminal lines fine and brown; broad brown bands subbasally, before antemedial, medial on costal half, before t.p. and marginal. The few nominal species are very close, and I suspect all one.

Sarsina purpurascens Walker

S. purpurascens Wlk. List Lep. Ins. Br. Mus. iv, 800, 1855.
Figured: Seitz **74**: e6 ♂, 7 ♀.
(For further nominal species possibly synonymous, see Seitz l.c.)

Larva (Mexico, U. S. Nat. Mus.). Dorsal hair (on i and ii) short, lateral long but of graded lengths on iii-v, wart iv subordinate to v; the lateral lobes of prothorax with long hair; mottled, with double dark dorsal line, black dorsal patch on front of metathorax; black about tubercles of 4th segment of abdomen and a fine oblique line down sides of 7 and 8. Pupa naked, suspended, smooth, ruptively colored, with a black dorsal triangle on front of thorax, whitish face-plate, etc. Jörgensen (l. c.) also describes the larva of *S. violascens* from Paraguay as having two large black and yellow eyespots on the metathorax. Food *Mikania scandens* (Compositæ).

Common (see diagram, p. 245) mostly females, 1 ♂. Ranges north to Mexico and in variants south to the Argentine.

Stætherinia Butler

Similar to Sarsina except as stated in key. Hind wing bent at Cu_2, wings squarish. General effect of shape and pattern like the Apatelodes group of Eupterotidæ, but in essential structures a typical Lymantriid.

Stætherinia corydona Druce (Fig. 65)

Tarchon corydona Dr. Biol. Centr.-Am. Lep. Het. ii, 445, 88: 8 ♀, 1897.
Also *figured:* Seitz **74**: g3 ♀.

Brown, with rather fine darker ordinary lines, and black and white st. points; the white in the points toward apex very conspicuous in a couple of dark specimens, and all but the black element of the st. dots obscure in three light ones. Hind wing deep ochre yellow (unlike *S. cayugana*, with its contrasty var. *valstana*), with two vague brown st. spots in the present series, typically lacking. Female as usual much larger with more pointed wings.

Common (see diagram, p. 245), males only. Chiriquí (Schaus).

Ab. *tarchona* Schs. (Seitz p. 553), with hind wing suffused with red-brown, was described from Panama (Fairchild), doubtless from Barro Colorado Id.

Desmoloma Felder

Fore wing with crowded venation, the male apparently with three simple veins representing the radial system, the first arising out of Sc. Hind wing with a large costal lobe, covering sex-scaling. Antenna with simple tip (unusual in the Lymantriidæ), only the pectinate part arcuate. Tympanum deep and far back, nodular sclerite massive; hood large, lower than usual.

A doubtful member of the family, though the plumed fore legs are normal and key characters agree.

Desmoloma chironomus Dyar

Mantruda chironomus Dy., Proc. Ent. Soc. Wash. xii, 83, 1910.
Figured: Seitz 74: g6 ♂, 7 ♀.

Fore wing brown, with green antemedial band, etc. Hind wing white with brown costal third. M_3 and Cu_1 short-stalked.

Jan. 2, 8, May 17 (Fried.), Feb. 12, 16, 26 (A.M.N.H.). Colombia.

Dyar reports *D. erratica* Schs., a small solidly dark species with M_3 and Cu_1 of hind wing connate (Seitz 74: h5).

NOTODONTIDÆ

Head generally prominent with strong tongue and ocelli, legs strong, generally heavily hairy, at least in male; thorax with tympanum forming the roof rather than the anterior side of its cavity, the supporting sclerites simpler than in the preceding families (Euchromiidæ to Lymantriidæ). (See Richards, Ent. Am. xiii, 32, 18: 155, 1932).

Fore wing with Cu apparently trifid, M_2 arising near middle of height of cell, or more often toward its upper angle; acc. cell typically present, frequently very long and sometimes reaching more than half way to apex. Hind wing with Sc and R closely parallel over middle part of cell, hardly ever fusing; commonly connected by a short bit of R_1 (the "cross-vein"); R and M_1 most often stalked, M_3 and Cu_1 usually free; M_2 from near middle of end of cell, more or less weak or even absent.

Larva with proleg hooks in a single simple series, much like the Noctuidæ, but with multiple setæ on outer side of prolegs and iv of 7th segment of abdomen much lower than on other segments, almost in line with v; occasionally with fine secondary hair (*Rosema*). Pupa usually showing the trifid Cu on the wing pad, but otherwise much like the Noctuidæ (see Mosher Bull. Ill. St. Lab. N. H. xii (2), 34, 125); in a dense parchment-like cocoon, or more often in the ground.

The best attempt at a classification is that in Packard's "Monograph of the Bombycine Moths", i. The Apatelodinæ should be excluded as having no tympanum, undivided epimera, thin flat-type egg, and larva with biordinal hooks on prolegs; and are related to the Eupterotidæ, Bombycidæ and Lasiocampidæ. In fact one or two of the supposed Eupterotidæ of eastern Asia are Apatelodinæ. The Ichthyurinæ (which should be called Melalophinæ) are distinct in both larva and imago, and Rosema with its stout densely hairy, humped larva and male genitalia with heavy bifid uncus, simple valves and simple last ventral segment must be related to them, though the venation is normal Notodontine. The Cerurinæ have the inflated valves and chitinized 8th sternite of the Notodontinæ, but differ in the retracted head, with weak tongue and no ocelli, loosely hairy legs, and especially larva with hind legs modified into long stemapods, and hairy lateral lobes of the prothorax. The residue, the Notodontinæ and Heterocampinæ of Packard should, I believe, be treated as a single subfamily, though they can be separated by the cleft or simple 8th sternite of the male, and have a different habitus both in larva and imago. Workers outside of North America have never recognized the separation, but they can be treated as two tribes, the Neotropical group (Hemiceras et al.) with M_2 of the hind wing lost, making a satisfactory third. In synopsis:

Melalophinæ: 8th sternite not specially chitinized, without pockets or modifications; uncus cleft, thick, valves not inflated, without hair-pencil; larva stout, humped, with dense fine hair even on head and bases of tubercles.

Melalophini: Radial branches concave toward costa; valves membranous, fan-like; main ventral support of genitalia formed of extensions of valves. Holarctic, extending into the Oriental.

Rosemini: Radial branches convex toward costa; valves narrow, chitinized, though with membranous border; main support of genitalia formed of the juxta. Neotropical.

PHALERINÆ: Similar to the Notodontinæ, but larva without humps, with fine dense hair on body only. Male with 8th sternite cleft, with 1 or 2 external pockets; valve with membranous border (like Rosema) but uncus enormous, simple, bearing large basal (scaphium-like) lobes. Old World and Nearctic.

NOTODONTINÆ: Genitalia with simple uncus, the basal lobes normally small, middle part of vinculum developed, valves largely membranous, frequently hollow with an enormous tuft; 8th sternite heavily chitinized. Larva with only simple hair above, frequently humped or even spined, prolegs hairy.

Notodontini: 8th sternite cleft, larva usually plain or with fleshy humps, and last prolegs usually fairly developed; acc. cell normally less than 1/3 way to apex.

Calledema group: Scape with hair longer above, frequently with a plume; fore wing with a raised antemedial scale-ridge or tuft in fold; antennæ simple.

Nystalea group: Similar, fore wing smooth.

Crinodes group: Third segment of palpus very short, antenna close-scaled above; abdomen more or less elongate in male, the terminal tuft sometimes exaggerated.

Dasylophia group: Similar to Nystalea group, antennæ pectinate, the pectinations ending abruptly at about half length.

Symmerista group: Similar, pectinations decreasing gradually, the scape never with a large plume.

Notodonta group: Fore wing with a lobe and tuft on inner margin, antennæ normally simple, M_1 arising from acc. cell beyond middle, upper side of scape close-scaled.

Heterocampini: 8th segment entire, sometimes covering a pair of pockets at its posterior border, larva usually plain or with acute bristly humps, in the former case with anal prolegs elongate, with reduced hooks, generally not functional. Acc. cell frequently reaching half way to apex when present.[1]

Hemiceratini: Hind wing with M_2 lost, the distance between M_1 and M_3 commonly decreased; larvæ smooth or nearly so with elongate but functional anal legs; otherwise near the Notodontini.

[1] The North American larvæ represent a Schizura group with humped and bristled larvæ and a Heterocampa group with smooth larvæ (after the first stage) and a tendency for the anal legs to become stemapods. Most of the few known South American larvæ belong to the first group.

CERURINÆ: Similar to the Notodontinæ. Head retracted, with weak tongue and no ocellus, palpi weak and normally hairy; 8th sternite simple or extended in middle; larva with long stemapoda and lateral hairy lobes on prothorax.

Artificial Key to Genera

1. Hind tibia with terminal spurs only (in the present species); ocelli absent, head very narrow behind eyes; palpi falling short of front, tongue almost obsolete; M_2 of hind wing arising from cell far above stem of M_{1+2} in cell, which is distinct; accessory cell very small or absent; antennæ pectinate nearly to tip in both sexes (*Cerurinæ*).....*Cerura*

   Hind tibia with all spurs; tongue and palpi weak and ocelli obsolete only when antennæ have a long simple tip, accessory cell is normal and M_2 of hind wing lost (Kaseria).....2

2. Hind wing with M_2 lost.....3
   Hind wing with M_2 well developed.....10

3. Accessory cell absent, R_2 stalked on R_{3-5}.....4
   Accessory cell normal (in a single specimen with acc. cell absent but R_2 free).....8

4. Fore wing with R_5 stalked beyond origin of R_2; apex squarely truncate; antenna pectinate.....*Colax*
   Fore wing with R_2 stalked beyond R_5; apex rounded; antennæ not pectinate.....5

5. Third segment of palpus nearly half as long as second; inner margin of fore wing lobed at middle; no silver.....*Antæa*
   Third segment of palpus short; fore wing not lobed at middle of inner margin; frequently with silver discal spot.....6

6. Fore wing with a large lobe at anal angle; male antenna with an oblique notch across scape and base of shaft above. . .*Rhapigia*
   Fore wing not lobed at anal angle.....7

7. A moderate amount of silver or golden scaling or none; male antenna with notch at base.....*Hapigia*

Fore wing very heavily marked with pale gold on a largely orange base; no notch on male antenna..... *Chliara*

8. Palpi very weak, tongue rudimentary, ocellus absent and back of head narrow as in Cerura; eyes very large..... *Kaseria*
Palpi upturned to middle of front or beyond, the tongue functional and ocelli distinct though sometimes covered by the vestiture..9

9. Space between M_1 and M_3 at margin of hind wing much broader than the interspaces above and below, as wide as in species with M_2 preserved; costa (in the present species) arched and wing oblong..... *Anita*
Space between M_1 and M_3 no wider than those above and below, the veins strongly convergent to margin..... *Hemiceras*

10. No accessory cell; palpus beak-like with a tuft on tip of second segment..... *Lusura*
Accessory cell present (reduced to a vestige in some *Dicentria*, which have no tuft on second segment of palpus); palpus normally upturned to middle of front..... 11

11. A scale-tuft near middle of inner margin of fore wing..... 12
No such scale tuft (occasionally one at anal angle)..... 15

12. Inner margin lobed, the scale-tuft very large..... *Apela*
Inner margin nearly straight, with a small scale-tuft..... 13

13. Very large species (over 50 mm.); R_5 stalked from the tip of the short but well formed acc. cell; hind wing with M_2 arising far above middle of end of cell..... *Naprepa*

Medium species, expanding under 50 mm.; R_5 arising from tip of acc. cell unless it is much reduced and stalked; hind wing with M_2 arising but little above middle of end of cell..... 14

14. Outer margin of fore wing sharply bent at M_3 and deeply scalloped below it..... *Astapa*
Outer margin evenly curved, the scallops only gradually becoming somewhat deeper toward anal angle..... *Dicentria*

15. Fore wing with an antemedial scale-tuft or group of parallel ridges where antemedial line crosses fold, the other raised scaling if present slight.....16
Fore wing smooth-scaled, or with the raised scaling widely scattered over surface of wing, the ridge in fold if present no stronger than one at end of cell.....18

16. Antemedial tuft in fold longitudinal, fan-like.....*Pentobesa*
Tuft a transverse ridge or two or three parallel ridges (somewhat fan-like but small and transverse in *C. arema*).....17

17. Hind tibiæ and tarsi close-scaled.....*Elymiotis*
Hind tibiæ with a long hairy fringe or tuft, the tarsi and spurs normally also tufted in male at least.....*Calledema*

18. Fore wing with M_1 arising from acc. cell definitely beyond its middle, the acc. cell reaching as a rule 1/3 way to apex or more.....19
Fore wing with M_1 arising from basal half of acc. cell or free, occasionally further out when acc. cell is very short (Nystalea, Betola).....21

19. Collar rising in a high transverse crest; front smooth and palpi short (as in Rosema) apex of fore wing rounded-truncate.
Canodia
Collar not distinctly higher than rest of thorax, palpi longer....20

20. Antennæ in both sexes with pectinations ending abruptly about middle; wings longer; vestiture smooth.....*Lirimiris*
Antennæ of male with pectinations decreasing gradually in length, simple in female; wings shorter and rounder; palpi with much loose hair.....*Peroara*

21. M_3 and Cu_1 of fore wing stalked, of hind wing connate but carried on an extension of the lower angle of the cell so as to appear stalked; thorax with high crests on tegulæ, abdomen with a larger tuft on 3rd segment and in male with a large fan-like anal tuft (♀ not seen).....our species of *Rincodes*
Fore wing with M_3 and Cu_1 connate or separate, lower angle of cell of hind wing but little extended, no high crests on thorax and abdominal tufts *normally* confined to basal segments....22

22. Scape of antenna with a dorsal plume; the plume more than twice as high as length of scape, and when not very long evenly sheared off; third segment of palpus 1/3 or more as long as width of eye, save in a few species of Nystalea.....23
Scape of antenna normally dorsally clothed with close scales or with a short raised ridge of normal scales, though frequently with a ventro-anterior plume; third segment of palpus normally short, sometimes hardly visible. Scape of antenna rarely (Phyllopalpia, Kalkoma) with dorsal hair-scales twice as long as length of scape, but in that case they are extremely loose and divergent.....31

23. Third segment of palpus much longer than width of eye, almost as long as second; male antenna pectinate half way to apex. *Didugua*
Third segment of palpus not longer than width of eye, when nearly as long the male antenna simple, ciliate.....24

24. Male antenna pectinate about half way to apex, then abruptly simple; pattern complex, frequently with special subterminal markings above anal angle.....25
Male antenna simple, ciliate or fasciculate.....26

25. R_5 strongly stalked from apex of acc. cell, R_2 free, from acc. cell.....*Betola*
R_2 strongly stalked from apex of acc. cell, R_5 more shortly or (normally) free.....*Dasylophia*

26. Male with palpus closely held, the third segment wholly above vertex, female with third segment nearly as long as width of eye and porrect; acc. cell symmetrically triangular, about half its length overlapping discal cell.....*Phedosia*[1]
Both sexes with palpus oblique, the third segment continuing the line of the second; acc. cell usually with no more than 1/3 its length overlapping discal cell.....27

27. R_5 arising from stalk of R_{3+4} well beyond end of acc. cell. *Nystalea* (in part)
R_5 arising very close to or before end of acc. cell.....28

[1] Female *Lepasta mixta* will run out here; it may be distinguished by the single pale discal lunule.

28. Cu_2 arising from cell about opposite R_1 or before (a very little beyond in *L. mixta*)..... *Lepasta*

Cu_2 arising well beyond origin of R_1, frequently opposite R_2....26

29. Apex minutely falcate, R_3 and R_4 forking about 2/3 way from tip of acc. cell to apex; pattern simple, normally with an oblique line to apex; base and inner margin forming a separate pattern-area..... *Strophocerus*

Apex not falcate; R_3 and R_4 forking about half way between end of acc. cell and apex; pattern usually more complex and of other type.....30

30. Wings ample; third segment of palpus as long as width of eye; M_1 of fore wing connate with acc. cell..... *Bardaxima*

Wings narrower and oblong; third segment of palpus noticeably shorter than width of eye; M_1 of fore wing from acc. cell. *Proelymiotis* and *Nystalea* in part

31. Hind wing with Sc parallel and well separated from anterior side of cell (connected by R_1), only gradually diverging.....32

Hind wing with Sc very close to cell on basal third, normally separated by less than its thickness, diverging more abruptly. 33

32. Hind wing contrastingly marked, normally blackish and buff. *Rhuda*

Hind wing with no contrasting markings..... *Blera*

33. Front of cell of hind wing strongly and regularly arched, Sc closely parallel to it and also arched almost to apex of cell; male antenna with downcurved shaft with long pectinations, Lymantriid like, only about 6 terminal segments simple..... *Kalkoma*

Front of cell of hind wing straight in general course except toward base, Sc more or less sinuous but not arched; male antenna simple, or with a larger number of simple apical segments, the shaft not arched.....34

34. Male antenna pectinate, the pectinations short and very gradually decreasing to a simple apical portion; female palpus with third segment more or less porrect; pattern dominantly diagonal. *Phyllopalpia*

Male antenna pectinate half way, more or less, then abruptly becoming simple.....35

Male antenna simple, ciliate or fasciculate.....38

35. Palpi barely exceeding front, which is oblique, with smooth vestiture; fore wing with R_1 far out, distinctly beyond Cu_2, and normally less than twice as far from R_2 as R_2 is from end of cell. Ground even green (fast to moisture).....*Rosema*

Palpi extending far beyond front or obliquely upturned to middle of face; front strongly bulging, with rougher vestiture; fore wing with R_1 usually arising before Cu_2, many times as far from R_2 as the latter from R_4. Pattern complex, the green color when present less bright and fugitive.....36

Palpi extending far beyond the small *flat* front; acc. cell very large, at least toward base; small slender species.....*Talmeca*

36. Hind wing with Sc and R of hind wing closely parallel for more than ¾ length of cell, abruptly diverging just before end of cell; costa with fringe enlarged; fore wing with M_1 arising from near base of acc. cell.....*Farigia*

Hind wing with Sc diverging abruptly from front edge of cell at ¾ or before; fore wing usually with M_1 arising at about half length of acc. cell.....37

37. Male hind wing below with oblique sex-scaling toward bases of costa and Cu, the costal fringe much enlarged (larva humped). *Malocampa*

Male hind wing without such special scales below, sometimes with loose shaggy hair; costal fringe various (larva smooth). *Disphragis*

38. Male antenna with bristles of basal half very long, and the shaft also widened, then abruptly decreasing in length; fore wing cream and red-brown with coarse transverse striation. . *Magava*

Male antenna with a notch at base of shaft, followed by a short fringe of stiff hairs; fore wing gray, normally with a contrasting

pale base sharply set off, and a double, diffuse more or less punctiform dark pm. line. . . . . *Drugera*

Fasciculations of male antennæ regular; patterns of various (mostly other) types 39

39. M_1 connate with base of acc. cell 40

M_1 arising a little way out on acc. cell 42

40. Hind tibia with rough bristly scaling its whole length; fore wing with some raised scaling . . . . . *Tachuda*

Hind tibia smooth scaled or with a little rough hair on upper half only; palpus extremely short 41

41. Smaller; abdomen of male moderately elongate, with minute terminal tuft; longitudinally streaked . . . . . *Antiopha*

Larger; abdomen very long in male, with wide fan-like or bifid tuft; markings transverse . . . . . *Marthula*

42. Very large species, hind tibia close-scaled or nearly so; anal tuft of male of long loose spatulate scales; third segment of palpus well set off, nearly half as long as width of eye; acc. cell relatively short, with about ¼ its length overlapping discal cell. *Crinodes*

Not very large species; hind tibiæ hairy above; anal tuft small or evenly cut off; third segment of palpus shorter, acc. cell longer, very shortly overlapping discal cell 43

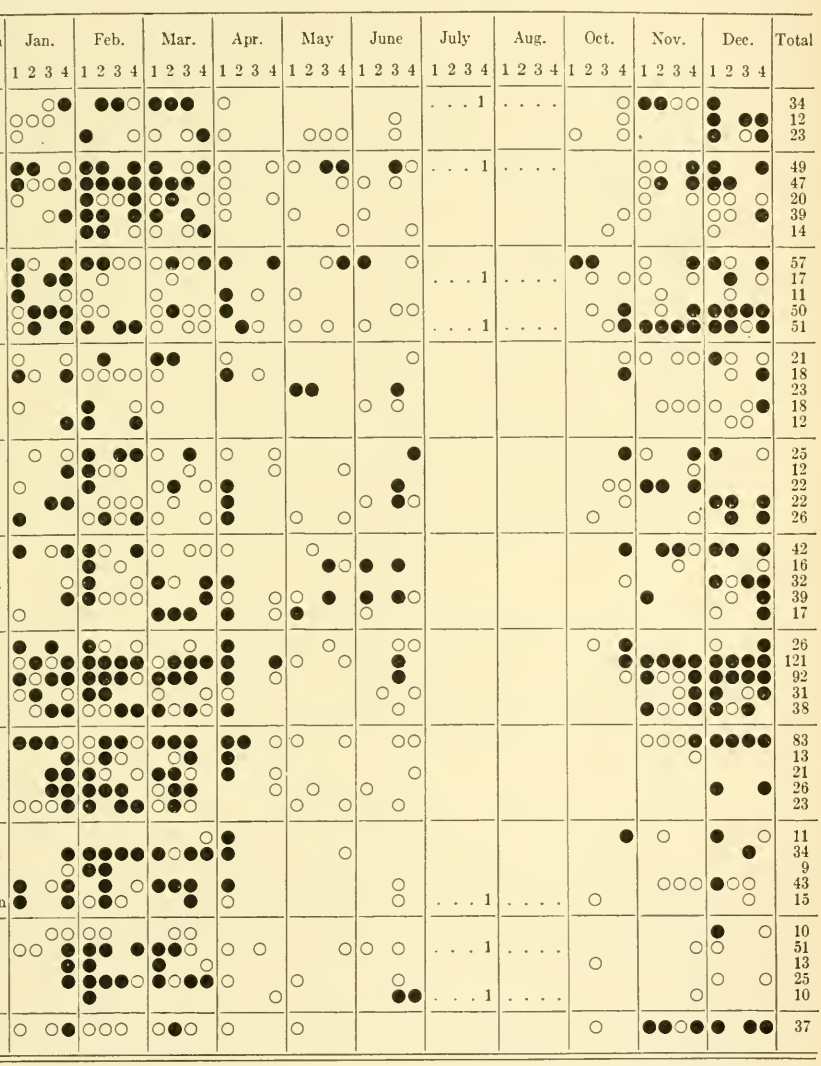
43. Hind wing with Sc and R closely parallel to ¾ length of cell or beyond; abruptly diverging close to end of cell 44

Hind wing Sc and R diverging more gradually at about ¾ length of cell . . . . . *Rifargia* and *Disphragis gelduba*

44. Present species with Sc and R widely separated on basal half of cell, enclosing a large humeral cell; fore wings broad and blunt. *Phastia*

Sc only moderately curving away from basal portion of cell, the humeral cell slender, normal; wings narrow, oblong, with marked apex . . . . . *Meragisa*

SEASONAL RECORD OF BARRO COLORADO ISLAND NOTODONTIDAE &c.



Subfamily MELALOPHINÆ

Rosema Walker (with *Moresa* Walker)

The genus Rosema is generally considered to belong to the Melalophinæ, on account of the larva as described by Stoll and Sepp. In fact it is not close to Melalopha, having a perfectly normal Notodontine venation, a fairly Notodontine head (best matched in Canodia) and distinctive type of genitalia, with the uncus of Melalopha, but most other structures either Notodontine or unique. The 8th sternite is lightly chitinized, but faintly to distinctly emarginate, approaching the Notodontinæ.

Front flat, closely and finely scaled, oblique, the palpi hardly exceeding it; antennæ ⅔ pectinate. Fore wing typically broad with arched costa; long with oblique outer margin and slight tuft on middle of inner margin in Moresa. Larva stout, humped, with elongate but functional prolegs; green, feeding on woody legumes.

1. Fore wing toothed below R_4 and M_1, and strongly excurved below; $_1R_5$ long-stalked; reniform large, black, a strong contrasting black border, narrow at M_3 and ending abruptly below Cu_1. *deolis*

Fore wing with even nearly straight outer margin; no black; reniform a white point; R_5 from apex of accessory cell. . . . *zelica*

Rosema deolis Cramer

Bombyx deolis Cr. Pap. Exot. i, 59, 36: F, 1775; Stoll in Cr. Pap. Exot. iv, 136, 360: B, 1787, ♀.

Larva: Stoll, Suppl. Cr. Pap. Exot. 76, 16: 6, 1790 (apparently this as *Bombyx nitida*); Sepp Surin. Vlinders iii, 117, 1855.[1]

R. apicalis Wlk. List. Lep. Ins. Br. Mus. v, 1169, 1855.

Also *figured:* Seitz 159: d3 ♂, 4 ♀ (typical) d5 ♂, e1 ♀ (*apicalis* as variety).

The name *apicalis* is identified by "Seitz" with specimens which have exceptionally large black reniforms. The Barro Colorado material is of the variety, but it is not in general local.

Larva with red lateral spots and subdorsal spots,—white on third segment of abdomen, anterior black and posterior white on 4, posterior white on 5, anterior black on 6. Food *Pterocarpus indicus.*

Jan. 27, Feb. 2 (Bts.). Mexico to Amazons.

[1] Möschler in Stett. Ent. Zeit. xxxix, 424, 1879 gives an account of this work (which he dates 1852). The material was largely gathered about 1790 by Governor J. G. Wichers and described by H. J. Scheller, who should possibly be credited with the authorship. So it is not unlikely that Stoll's and Sepp's figures were based on the same *specimens;* they look remarkably similar.

Rosema zelica Stoll (Fig. 30)

Bombyx zelica Stoll in Cr. Pap. Exot. Suppl. 73, 16: 2 (*larva*), 2C (*pupa*), 2D (*imago*); Sepp Surin. Vlinders ii, 181, 79 (with larva). c. 1850.
Rosema dorsalis Wlk. List Lep. Ins. Br. Mus. v, 1169, 1855.
R. z. f. *minor* Ddt. in Seitz. Macrolep. World vi, 1055, 159: c5, 1934.
Also *figured:* Seitz 159: b1 (normal), 2, 4 (*dorsalis*).

Type form with thorax all green, var. *dorsalis* with a contrasting brown patch. All from Barro Colorado Id. are of the variety. The type seems very rare, but is in the Nat. Mus. from R. Maroni, French Guiana.

Larva with fine subdorsal yellow or tawny lines and small lateral spots; on Pterocarpus (?) (Sepp). Figured by Stoll on pineapple, certainly in error.

Dec. 30–Mar. 6. Ranges in races to Brazil.

Subfamily NOTODONTINÆ

Characters as in the synopsis (above). The subfamily and its typical tribe are world-wide, the Heterocampini are best known from America, the Hemiceratini purely Neotropical.

Tribe NOTODONTINI

The typical Notodonta group is Holarctic, but Apela, and perhaps Lusura and Peroara are outliers. The majority of Neotropical species group about Nystalea, with simple brush-like antennæ, simple fore wings, and a strong tendency to develop a plume on the base of the antenna. The genera of this group are very closely related and tend to intergrade.

Calledema Butler (with *Pseudantiora* Kirby, *Antiora*‡)

M_1 arising from before middle of acc. cell, frequently near base; M_2 from upper angle of cell or near it, R_2 sometimes shortly stalked; antennal plume rudimentary in the type species, otherwise long; hind leg with tarsi and spurs tufted as well as tibia except in *C. arema*.

Each species has distinctive structures, but there is no special cleavage at the point where Schaus separates Calledema and Pseudantiora.

‡ Double dagger to indicate *misuse* of name.

1. Fore wing with a silver dash beyond cell, along lower edge of M_2; terminal space crossed by diagonal white lines (representing the adterminal line); ground dark 2
   Two oblique silver stripes in antemedial region and conspicuous brilliant bronzy areas . . . . . *Lysana plusiata*
   Fore wing without silver postmedial or antemedial stripes; terminal area without oblique lines; ground pale with dark oblique shade and st. spot 3
2. Silver bar thick, free at basal end; a smaller species with dorsal plume on antenna and hind tarsus close-scaled . . . . . *arema*
   Silver bar fine, connected to an oblique white patch at middle of costa; no dorsal plume; male hind tarsus with hairy tufts. *marmorea*
3. A thick brown-black bar from costa near base over M_3 and Cu_1 to margin; ground yellowish . . . . . *contingata*
   This bar thin and shading into the ground below, defined only on upper side 4
4. Ground shaded with reddish . . . . . *rufescens*
   Ground light gray . . . . . *jocasta*

Calledema marmorea Butler (Fig. 31)

C. marmorea Btl. Trans. Ent. Soc. Lond. 1878, 65; Schaus Trans. Ent. Soc. Lond. 1901, 264 (in list only); Dyar Proc. U. S. Nat. Mus. xlvii, 223, 1914.
Figured: Seitz 143: a1.
(Omitted from Lep. Cat.).

Antennæ with dorsal scaling of scape only about twice as long as ventral, not forming a true plume; fore wing with M_1 and M_2 approximate for a distance near origin, then diverging; hind tarsus with tufts on first two segments. Genotype of *Calledema*.

Ground mouse gray. *C. sodalis* Btl., described by Butler in the same paper, is almost identical in pattern but has the high tuft and divergent M_1 and M_2 of Pseudantiora, also a close-scaled hind tarsus.

Late Nov.–May (see diagram, p. 245). Guatemala to Amazons and Espirito Santo, Brazil.

Calledema arema Schaus

C. arema Schs. Proc. U. S. Nat. Mus. xxix, 231, 1906.
Figured: Seitz 143: a4.

Acc. cell extending almost half way to apex; plume of antenna high; M_2 well below angle of cell; hind tarsus close-scaled.

Small with strongly contrasting silver bar,—without the bronze areas of *L. plusiata*, but with some yellowish silver before the antemedial tuft.

Feb. 3-June 23 (see diagram). Costa Rica to Guiana (type) and Upper Amazons.

Calledema jocasta Schaus

C. jocasta Schs. Trans. Ent. Soc. Lond. 1901, 264.
Figured: Seitz 143: a5 (head and prothorax should be dark and contrasting).

Plume strong, M_2 from close below angle of cell, diverging; hind tarsus with long hair on basal segments; acc. cell short (as in the following spp.). R_2 usually stalked, M_1 about 1/3 way out on acc. cell. Light gray.

Feb. 14, 22 (Weeks, A.M.N.H.) 23 (Bts.) Mar. 3 (Fried.). Guatemala to Rio de Janeiro, common on the Amazon.

Calledema rufescens Schaus

Pseudantiora rufescens Schs. Proc. U. S. Nat. Mus. xxix, 235, 1906.
Figured: Seitz 144: h6.

R_2 short-stalked, M_1 from base of acc. cell. Large, the fore wing decidedly redder below the diagonal line than above.

Dec. to June (see diagram). Guatemala to Guiana and Amazons.

Calledema contingata Möschler

Antiora contingata Msch. Verh. z.-b. Ges. Wien xxxii, 347, 18: 35; 1883.
Also *figured:* Seitz 144: h5.

R_2 variable; M_1 from acc. cell at 1/3. This is the genotype of Pseudantiora. The brown ruptive pattern on a grayish yellow base is distinctive.

Dec. 31, 1934 (Fried.). Ranges to Guiana and Santa Catharina, Brazil.

Dyar reports *Lysana plusiana* Schs. from the Canal Zone. The antennæ are heavily serrate, plume enormous; it is small, brown, brilliantly marked with lilac gray, copper, and silver lines.

Elymiotis Walker

Similar to the preceding genus, but with inconspicuous lichen-like pattern, sometimes with green. Fore wing narrower; plume rudimen-

tary or distinct; acc. cell very short, R_5 stalked; M_2 arising almost 1/3 way down on cell; outer margin more erect than in Pentobesa, and antemedial tuft narrow, ridge-like. Silver bar of typical Calledema represented by a minute Y-mark. (See Fig. 32)

1. *Male* with a black spot in fold, and a series in st. area above the white Y, which is isolated; *female* blackish with only the white Y distinct. . . . . *ancora*
   Male without black spots or shades, the Y obviously part of a fine dentate st. line; *female* not seen . . . . . *alata*

Elymiotis ancora Felder

Nystalea ancora Fld. Reise Novara Lep. 97: 8 ♂, 1874.
Amphipyra purpurascens Btl. Trans. Ent. Soc. Lond. 1879, 37 ♀.
Elymiotis attenuata Schs. Trans. Ent. Soc. Lond. 1901, 272 (in part, not Walker).
Also *figured:* Seitz 144: f3 (♀, as *purpurascens*).

The true *attenuata* has a larger and plainer male, if I have identified it correctly. The National Museum material is sorted differently on characters which I have not recognized.

Jan. 22, May 19 (Bts. Fried.). Amazons. As the National Museum material is sorted "*purpurascens*" will range from Costa Rica to Bolivia.

Elymiotis alata Druce

Edema alata Dr. Proc. Zoöl. Soc. Lond. 1890, 510; Biol. Centr. Am. Lep. Het. 90: 12.
Also *figured:* Seitz 144: f2.
? *Edema audax* Dr. Ann. Mag. Nat. Hist. (7) vii, 76, 1901.

Fore wing faintly shaded with green. *E. audax* as determined in the National Museum only differs in having no black shade at the tuft of the fore wing.

Oct. 31, 1934 (Bts.). Honduras to French Guiana.

Pentobesa Schaus

Similar to Calledema and Elymiotis; male antennæ heavily serrate; plume good sized; fore wing rough-scaled; the antemedial tuft fan-like in both sexes; venation of Elymiotis, but apex of fore wing rounded over; M_2 arising from middle of end of cell.

I consider this genus monotypic, *P. valta* having none of its distinctive characters. It may perhaps find a place in Nystalea.

Pentobesa xylinoides Walker (Fig. 33)

Edema xylinoides Wlk. List Lep. Ins. Br. Mus. xxxv, 1931, 1866.
Symmerista pinna Dr. Biol. Centr.-Am. Lep. Het. i, 239, 25: 9 ♀, 1887.
Also *figured:* Seitz 144: b4 ♂, 5 ♀.

Fore wing with a complex dead-wood pattern, much paler in female; male with pale greenish tegulæ.

Common (see diagram, p. 245). Mexico to Southern Brazil.

In the following genera the plume is usually present (reduced to a fringe in Tachuda and some Hippia and Nystalea), third segment of palpus long and well set off, and hind tibia with loose hair, often extending onto the tarsus in male. The fore wing is smooth.

Nystalea Guenée

The central genus of the group, in which all species with smooth wings and simple antennæ have been placed which do not belong definitely elsewhere. Plume usually short (long in *superciliosa*), fore wing long with apex typically pointed, but square in the *lophocera* group; acc. cell with R_5 shortly stalked (free in most specimens of *N. lophocera*), M_1 from middle of acc. cell in *N. ebalea*, the genotype, but usually near the base. Larva, according to Seitz, similar to Notodonta (i.e. presumably with fleshy humps on 2 or 3 anterior segments, and a sharper one on 8th abdominal).

1. Fore wing with a black centered ocellate subapical spot; with light reddish spot in end of cell, contrasting with a larger blue-gray shade beyond. . . . . *ocellata*
   No conspicuous black spot near apex of fore wing. 2
2. Fore wing with outer margin oblique, R_5 strongly stalked, antemedial line converted into practically longitudinal striation. . 3
   Fore wing with outer margin erect toward apex, the subterminal line nearly even and parallel to it; antemedial line but little irregular, somewhat offset on Cu 4
3. Plume on antenna short, not distinct from the rest of the fringe on scape; fore wing with subterminal line broken into dots; a pale costo-apical spot, one at middle of costa, and often a black-centered ocellus in fold. . . . . *ebalea*
   Plume high; ground as a rule evenly dark brown; st. line fine, twice as far from margin toward apex as lower down. . . . . *superciliosa*

4. Plume long and conical; larger species, the transverse lines less conspicuous, and adterminal line formed of fine black dots, two to an interspace.....5

   Plume short and rounded; transverse lines almost completely traceable, double; st. line nearly complete, black, fine, parallel to outer margin.....6

5. Fore wing blackish with contrasting light wood colored costo-apical spot, — the subterminal dots above anal angle emphasized.....*porgana*

   Fore wing mottled light gray, often brown toward inner margin; st. dots all alike.....*nyseus*

6. Male with a large plume of oblique hair-scales at 3/4 its length; hind tibia with a moderate fringe of long hair, continued almost as wide on base of tarsus; under side of abdomen with much fine erect hair; ante- and postmedial lines not brownish, and not accompanied by brown shading; usually four contrasting blackish spots along fold.....*lophocera*

   Male with practically simple antenna; hind tibia with a very massive tuft, the tarsus with a few loose hairs at base only; under side of abdomen heavily clothed with extremely long hair; inner t. a. and outer t. p. lines more or less contrastingly dark brown, the upper half of postmedial area shaded with light brown; blackish spots in fold usually only 2 or 3 and not contrasting.

   plumipes

Nystalea ocellata Rothschild

N. ocellata Roth., Nov. Zoöl. xxiv, 233, 8: 5, 1917.
Also *figured:* Seitz 143: i1.

More warmly colored than the other species; easily separated from all Notodontidæ known to me by the black subapical spot, asymmetrically placed in a circular pale patch. Male characters not studied.

Jan. 7 (Fried.) 1 ♀. Guatemala to Guiana and Bolivia.

Nystalea ebalea Cramer

Noctua ebalea Cr. Pap. Exot. iv, 91, 310: C, 1781.
Nystalea conchyfera Guenée, Sp. Gen. Ins. Lep. Het. vi (Noct. ii) 122, 9: 2, 1852.
Nystalea ebalea Forbes, Sci. Surv. P. R. xii, 45, 1930.
Also *figured:* Seitz 143: e3.
Larval *food:* Gundlach, Contr. Ent. Cubana i, 282, 1881.

The ground may vary from light gray to dark brown, or the inner

edge may be paler; the ocellus in the fold may be single, double or obscure.

Oct. 9, 22 (Bts.) June 25 (Fried.). Antilles, Mexico to southern Brazil.

Nystalea superciliosa Guenée

N. superciliosa Gn. Sp. Gen. Lep. Het. vi (Noct. ii) 123, 1852.
Figured: Seitz 143: i5.

Nearly plain dark brown, the thorax either concolorous, or cream or buff and contrasting.

Oct. to June (see diagram, p. 245). Mexico to Guiana and S. Brazil.

Nystalea nyseus Cramer

Noctua nyseus Cr. Pap. Exot. i, 119, 75: E, 1779.
Cyrrhesta nyseus Gundlach, Contr. Ent. Cubana i, 280, 1881.
Nystalea nyseus Forbes, Sci. Surv. P. R. xii, 45, 1930.
Also *figured:* Seitz 144: a1.

The ground is very light, flecked with gray, and the dorsum is usually shaded with light brown.

Jan. 30, 1934 (Bts.) July ? (Fairchild, without label). Antilles; Mexico to Guiana and Tucuman. The Fairchild specimen is a very large female without the usual dorsal brown shade.

Nystalea porgana Schaus

N. porgana Schs. Proc. U. S. Nat. Mus. xxix, 232, 1906.
Figured: Seitz 143: e6.
? *N. difficilis* Draudt, Seitz' Macrolep. World vi, 909, 143: f2, 1932.

The specimens (both females) agree in size with *porgana*,—in the dark color, and the accenting of two adterminal dots above the anal angle, with *difficilis*. Schaus is inclined to consider all one species. Male gray, female blackish in both types, and the distributions overlap.

Dec. 22 (Bts.), June 21 (Fried.). Specimens without the accented dots (*porgana*) are at hand from Guatemala to French Guiana and the middle Amazons, specimens with (*difficilis*), from Costa Rica, Colombia. Guiana and Sta. Catharina, Brazil. It was described from the middle Amazons.

Nystalea plumipes Schaus

N. plumipes Schs. Trans. Ent. Soc. Lond. 1901, 268.
(The figure in Seitz, 143: h3 labelled plumipes looks more like *N. longicornis* Felder.)

The light brown varies in amount but appears always visible; the antemedial line is markedly excurved over the costa and cell, unlike *longicornis* (*plumipes* of Seitz). Ground shaded with pale green; a poor specimen from the Amazons darker and browner, perhaps a good race.

Nov. 12-Apr. 5, July ? (Fairchild without label). Ranges to Guiana and the Upper Amazon.

Nystalea lophocera Dyar (Fig. 38)

N. lophocera Dy. Proc. U. S. Nat. Mus. xlvii, 223, 1914.
Not *figured.*

Larger and paler as a rule than the preceding, with little or no green. The outer spot in the fold is subterminal in *plumipes,* before the pm. line in *lophocera.*

Oct.-June (see diagram, p. 245). Known only from the Canal Zone, unless a bad female in the Nat. Mus. from French Guiana belongs here.

Phedosia Möschler

Palpi upturned to vertex with erect third joint in male, oblique, with porrect third joint in female (notably beaklike in an undescribed species in the Nat. Mus.). Acc. cell very short, only about half beyond the cell; R_5 free, R_3 and R_4 stalked half way to apex; R and M_1 of hind wing short stalked (free according to Schaus). A development of Nystalea, perhaps nearest *N. ocellata.*

Phedosia turbida Möschler

P. turbida Msch. Verh. z.-b. Ges. Wien xxvii, 691, 10: 49, 1878. ♂
Proelymiotis apicenotata Dgn. Ann. Soc. Ent. Belg. lii, 75, 1909.
Bardaxima hippioides Schs. Ann. Mag. Nat. Hist. (8) vii, 263, 1911 ♀.
B. castaneobrunnea Roth., Nov. Zoöl. xxiv, 234, :4 4, 1917 ♂.
Also *figured:* Seitz 144: e3 ♂.

Extremely sexually dimorphic. Male smoky gray-brown, with complex pattern, a little green before antemedial line, reniform a double

dark lunule, some st. black dashes and a mottled costo-apical spot; female with the basal lunule of the reniform extended in a black bar, with a white wedge above and beyond it, and apical spot extended in a streak toward the cell.

Jan. 23 ♂ (Fried.), Dec. 23 ♀ (Bts.). Guatemala to Guiana and Amazons.

Proelymiotis Schaus

A derivative of Nystalea, and hardly distinct; also very close to Lepasta. Plume large; third segment of palpus about 1/3 as long as the very thick 2nd; fore wing with R_2 and R_5 from acc. cell, M_1 from base of acc. cell (*joanna*) or connate (*æquipars*); M_2 a third way down. Costa of hind wing straight, but fringed with long hair in *joanna*.

1. Base and subapical spot of fore wing blackish, contrasting with rest of outer half ..... *æquipars*
   Ground light gray, with contrasting darker marginal shades and spots ..... *joanna*
   Markings more complex, with a small silver st. lunule in cell M_3 ..... *lignicolor*

Proelymiotis æquipars Walker (Fig. 34)

Nystalea æquipars Wlk. List Lep. Ins. Br. Mus. xv, 1742, 1858.
Proelymiotis æquipars Schs. Trans. Ent. Soc. Lond. 1901, 273; Forbes, Sci. Surv. P. R. xii, 46, 1930.
N. dirisa Msch. Verh. z.-b. Ges. Wien xxxii, 343, 18: 32, 1883.
Also *figured:* Seitz 144: g3.

Base dark brown with longitudinal streaking, as in many Nystaleas, outer part mottled pale gray.

July-Aug. (Fairchild). Cuba and Porto Rico, South America generally.

Proelymiotis joanna Schaus

P. joanna Schs. Proc. U. S. Nat. Mus. xxix, 234, 1906.
Figured: Seitz 144: h3.

Male darker than female, the brown inner margin and marginal streak opposite cell not really contrasting. Wings more oblong than in *æquipars*.

Dec. 23, Jan. 29 (Bts.). Guatemala, Guiana, Upper Amazons.

Proelymiotis lignicolor Möschler

Dasylophia lignicolor Möschler, Verh. z.-b. Ges. Wien xxvii, 687, 10: 46, 1877.
Tifama exusta Btl. Trans. Ent. Soc. Lond. 1878, 68, 3: 10.
P. arpia Schs. Trans. Ent. Soc. Lond. 1901, 273.
Also *figured:* Seitz 144: h1 (unrecognizable).

Closely similar to the species of Dasylophia, and even more to *Betola aroata,* but less contrasting; palpi striped as in Didugua; plume high; fore wing brown with complex wood-pattern, partly defined with black; a small st. white lunule in cell M_3, and white streaks or bars in interspaces above it; inner margin from basal third to anal angle broadly but irregularly ash gray, usually contrasting, but changing to an obscure buff in the faded male type of *arpia* and a male in the Cornell collection.

Oct. 3, Jan. 12, 21, Feb. 2 (Bts.); La Venta (Bts.). Guiana and Brazil.

Bardaxima Walker

Distinguished only by the key characters. A heterogeneous looking genus which is probably not to be kept, but the species agree in the rather broad ample wings. (See Fig. 35)

Schaus credits *Bombyx longara* Stoll (Suppl. Cr. Pap. Exot. 18: 3, 3G) to Bardaxima, though the figure looks more like Elymiotis. Its larva is slender with large head, dark brown with contrasting whitish flecks and streaks, those on the side oblique. It rests with front of abdomen humped and hind legs raised and feeds on "Cerisier sauvage de Suriname."

Bardaxima perses Druce

Heterocampa perses Dr. Ann. Mag. Nat. Hist. (7) v, 516, 1900.
Bardaxima demera Schs. Trans. Ent. Soc. Lond. 1901, 270.
Figured: Seitz 144; d2.

Large, pale gray, checkered with blackish, the ordinary lines waved and duplicated; adterminal line more regularly waved than usual, interrupted by a luteous apical ocellus with black pupil.

July ? (two females without label from Fairchild, det. Schaus). Guiana and Amazons.

Lepasta Möschler (*Poresta* Schaus)

Acc. cell narrow, mostly beyond discal cell; M_1 connate or from its basal third, R_5 typically barely stalked, M_2 a third way down the cell

or more, the mdcv. strongly oblique in; wing rather narrow, outer margin nearly even, normally emphasized by a group of parallel admarginal lines. Plume strong.

1. Fore wing with a silver streak or bar below M_2; border formed of about 5 nearly even and parallel lines and shades.....2
   Fore wing without silvery markings; adterminal line at least, irregular and lunulate.....3
2. Similar silver bars below 3 alternate veins (R_5, M_2, Cu_1); a distinct, rather paler costal area, reaching across to inner margin at base. *concordens*
   A single silver bar below M_2, the rest of the wing rather even, striate in a dead wood pattern, partly defined with green. *bractea*
3. Outer third rather evenly olive gray, with a slender lunulate st. line, the postmedial partly white and distant; an irregular pale costal patch and inner third.....*maltha*
   Postmedial far out, irregular and preceded with black shading, the basal 2/3 of wing with wood-like longitudinal shading, st. highly irregular, in a partly gray area.....*mixta*

Lepasta bractea Felder

Nystalea bractea Fld. Reise Novara Lep. 97: 3, 1874.
L. bractea majorina Dgn. Hét. nouv. Am. Sud. vii, 20, 1914.
L. gigantea Roth., Nov. Zoöl. xxiv, 235, 1917.

This is the genotype. The third segment of palpi is exceptionally long. Var. *majorina* (*gigantea*) is a little larger and darker. It was described from Col. and Ecuador, but I have it in series from Sta. Catharina, Brazil, and the typical form from Rio.

Feb. 2, 3 (Bts.—typical). Mexico to S. Brazil.

Lepasta concordens Dyar

L. concordens Dy. Proc. U. S. Nat. Mus. liv, 356, 1919.
Not *figured*. (Resembles *L. grammodes*, Seitz 145: f2).

L. conspicua Btl. is rather smaller, and the white st. line is in contact with the following black one, while in *concordens* they are separated by a gray line. Third segment of palpus more than half as long as second.

Oct.-Jan. (see diagram, p. 245). Mexico to S. Brazil. (See Fig. 36)

Lepasta mixta Möschler

L. mixta Msch. Verh. z.-b. Ges. Wien xxxii, 349, 18: 37, 1883.
Nystalea calophasioides Kaye, Trans. Ent. Soc. Lond. 1901, 137, 5: 2.
Also *figured:* Seitz 144: k6.

M_1 hardly stalked on acc. cell, which is shorter than in the other species. Fore wing with the dead-wood pattern more contrasty than *L. bractea*, on a yellow ground, but none of the specimens seen are as yellow as Seitz's figure.

Nov.-May (see diagram). Ranges to Guiana and Upper Amazons.

Lepasta maltha Schaus

L. maltha Schs. Proc. U. S. Nat. Mus. xxix, 239, 1906.
Figured: Seitz 145: f4.

Pale gray with brown (somewhat olive) areas and markings partly defined with pure white. Barro Colorado specimens correspond to Seitz's figure, and are larger and less bright than a set from Guiana.

Late Oct. to June (see diagram, p. 245). Guatemala to Surinam.

Strophocerus Möschler (*Poresta* Schaus in part, not type)

Like Lepasta, the fore wing more triangular, with more acute apex; R_3 and R_4 longer stalked, forking two thirds way from end of accessory cell to apex. Markings distinctive, usually solid brown, with a contrasting gray band on inner margin and an oblique postmedial band or shade from near middle of inner margin to apex. (See Fig. 37)

1. Fore wing with pale striation, the discolorous inner margin narrow, wholly below A, not contrasting, with a white spot above it at base. . . . . *albonotatus*

   Fore wing with brown ground even; inner margin pale powdery gray, contrasting, extending across to base of costa, with a silver lunule above it on outer margin. . . . . *punctulum*

Strophocerus albonotatus Druce

Poresta albonotata Dr. Ann. Mag. Nat. Hist. (8) iii, 466, 1909.
Figured: Seitz 145: e1.

More orange than the following, the hind wing tawny, nearly concolorous. Antennal plume massive.

Oct. 31, Dec. 26 (Bts.). Guatemala to Guiana and Bolivia.

Strophocerus punctulum Schaus

Poresta punctulum Schs. Ann. Mag. Nat. Hist. (8) vii, 264, 1911.
Figured: Seitz 145, e2.

Hind wing fuscous. Too close to *S. thermesia* Fld., Reise Novara 97: 9.

Jan. 3 (Bts.), Feb. 24, May 6 (Fried.), Honduras (Bts.), Costa Rica (type). Ranges to Guiana and the Amazons, a pale race from Southern Brazil.

Tachuda Schaus (*Naduna* Schaus)

Fringe on upper side of scape much reduced, narrower than on inner and lower sides, dominated by the tuft on vertex, but recognizable (unlike the Crinodes group). Accessory cell very short, about half overlapping the discal cell; M_1 free. Vestiture of head shorter than in most of the preceding genera, but with a distinct median ridge. Palpi closely upturned to vertex, third segment 1/3 as long as second, but well set off. The species are closely similar, dark with fairly complete but not contrasting markings, narrow wings and usually some pale or bronzy green. They are universally misidentified. In the four Panama species the ground is fuscous brown, usually shaded with green, the transverse lines, waved, multiple, and mostly inconspicuous; the antemedial and subbasal well out, usually triple; postmedial of two pairs of lines, the inner pair cut or marked by a tawny spot opposite cell, the subterminal irregular, several of its teeth usually accented by blackish shades, the adterminal of a series of black dots, 1 to 3 of which at the costa are accompanied by yellow dots; reniform a raised black bar with a white dot at each end.

1. Outer pair of pm. lines nearly erect, covered by a blackish band which starts just beyond them at the costa, and then covers them nearly or quite to inner margin; inner t.p. lines erect at inner margin, and preceded by a contrasting whitish line; median area glossy, blue-green, narrow; the base coal black as a rule, obscuring the subbasal lines. Sth sternite with lobes very close together and simple, the left much longer..... *discreta*

   All four pm. lines obscure and parallel, strongly oblique in to inner margin when traceable; the median area all clear green and brown, without whitish before pm. or at most a small spot opposite cell; subbasal line as distinct as the others.....2

2. Outer postmedial more or less shaded with black and contrasting on upper half, with a black st. spot beyond it below M_3; left lobe of 8th sternite broad and blunt, separated by rather more than its width from the narrow right lobe..... *pachydexius*
   Outer postmedial without any blackish shading, the whole ground of the wing without contrasts, rather evenly brown and green or wholly brown or blackish.....2
3. A distinct outer pm. dot above M_3; blackish border of under side of hind wing narrow, less than a third as wide as length of wing; left lobe of eighth sternite narrow and close to right lobe, but with a broad hump on its outer side..... *punctum*
   Pm. without any contrasts at all; border of under side of hind wing extending nearly half way to base; 8th sternite symmetrical, with two widely separated triangular lobes..... *albosigma*

Tachuda discreta Schaus

Tachuda discreta Schs. Proc. U. S. Nat. Mus. xxix, 241, 1906.
Not *figured.*

The original description included the following species, but the holotype is the present, which was the form primarily intended by Schaus. The wings are broader than in the other species, especially in the female. (Fig. 15, male genitalia.)

Nov.-Dec. (fresh females), Jan. 31, Feb. 3 (very bad males). Ranges to Guiana and southern Brazil.

Tachuda pachydexius, new species (Fig. 41)

T. discreta Schaus, Proc. U. S. Nat. Mus. xxix, 241, 1906 (in part, not type).
Figured: Seitz 145: f5 ♂ (as *albosigma* in error).

Similar to *T. albosigma* Druce. Last sternite (fig. 17) with terminal portion tapering to a little more than a third its width, gradually and evenly on left side, more abruptly and somewhat less on right; end with two free chitinized lobes, the left one bluntly rounded over or squarish, about as wide as long, the right one half as wide, and separated by a squarish notch a little wider than the left lobe. Uncus on a long extension of the tegumen (like *discreta*, unlike *albosigma*) with a large high membranous longitudinal keel above; membrane of outer half of valve triangular, tapering to apex, — unlike *discreta* where it is twice as wide near apex as at base; striations of lining of pocket in basal half

curving back on themselves at apex (converging in a radiate way in *discreta*).

Dull brown (the same color as the other species), shaded with slightly glossy green, decidedly in costal area and cell toward base, and quite strongly in median area over forkings of veins from upper and lower angles of cell and broadly over A; basal line waved, triple, dark, a little emphasized on veins, nearly erect; antemedial triple at costa, strongly excurved, and its outer line fine, black and continuous to A, where it is retracted and marked by a blackish dot; inner lines fading out below costa; pm. line with first pair of lines distinct, oblique out from costa to opposite lower angle of cell, the first fine below costa, the second red-brown opposite cell, and lying on a pale tawny spot, obscure and parallel to outer margin from there to inner margin; outer lines of t.p. parallel, mostly obscure, but covered by a black shade which starts from a diffuse dark gray patch extending to apex, becomes a definite fascia opposite cell and fades out about at Cu_1, thence the lines inwardly oblique (when traceable) to inner margin; st. of three or four small blackish shades, three at costa and a larger one in a pale shade below M_3, adterminal dots as usual, the first one with a pale yellow dot before it and the next one or two with minute yellow points. Hind wing dull luteous, the outer half deep gray-brown, without definite boundary; fringe contrasting dull white (as usual). Head and collar typically black-brown above, varying to dull luteous, especially in female. Abdomen, legs and palpi as in the other species.

Barro Colorado Id., Panama, Oct. 20, 1934, (Bates) and about 50 paratypes in M. C. Z., American Museum of Natural History and Cornell University (see diagram, p. 245); paratypes St. Laurent, Maroni, French Guiana and Viçosa, Minas Geraes, Brazil, June 4, 1931 (Hambleton) in Cornell University.

Female slightly shorter-winged than male, the green of median area perhaps a little stronger toward inner margin, but not as noticeably as in *T. albosigma*. For dates in Panama see diagram.

Tachuda albosigma Druce

Lochmæus albosigma Dr. Biol. Centr. Am. i, 236, 1887, ii, 457, 90: 17, 1898.
Also *figured:* Seitz 145: gl (as *discreta*).
? *T. nefanda* Draudt in Seitz Macrolep. World vi, 928, 145: f6, 1932.

The male is like Seitz' figure of *nefanda*, the female well represented by his figure of "*discreta*" which looks like a copy of Druce's *albosigma*. The principal difference is the much more conspicuous green of the

usual female, especially on the middle of the inner margin. There is a well marked variety without green, and one in the Barro Colorado lot with the black shade-dots much emphasized, especially along the st. line. Its genitalia agree with normal *albosigma* (fig. 18).

Not rare (see diagram, p. 245). Ranges north to Mexico (*nefanda*), the southern range not certain, from confusion with other species.

Tachuda punctum, new species

Last sternite (fig. 16) broadly rounded over, almost in a semi-circle, with two small subequal lobes at middle of end, with a small deep notch between them. Uncus on an extended tegumen, not as long as in *T. pachydexius*, but much longer than in *T. albosigma;* dorsal prominence very small and densely hairy; valve with essential structures of *T. pachydexius*, the plates more numerous (about 50) and basal ventral sclerite more convex at middle.

Externally almost exactly like *T. albosigma*, the usual lines almost wholly reduced to vein points (like the least marked specimens of the two preceding); but a single contrasting black dot above M_3 marking the outer t.p. Hind wing above like the other species, below with a moderate brown border, only extending about 1/3 way in to base, or a little less; the usual dark pm. line only indicated by a short costal bar at 3/5, with a wide space between it and the outer dark shade.

Lancetilla, Tela, Honduras, May 5, 1935 (Bates) type in M. C. Z.; Barro Colorado Id., Panama, Nov. 24, 1934 (Bates) paratype retained for Cornell University; both males. The female may possibly be confused with *T. albosigma*.

The three following genera form a subgroup distinguished from the Nystalea group by the closer scaling of legs, front and scape above, and very short third segment of palpus; Tachuda is transitional, as the genitalia show. Crinodes is an extreme development, but obviously connected to Marthula, one species of which even has the loose terminal tuft of the abdomen. It looks like a Sphinx.

Antiopha Schaus

Acc. cell rather short, R_5 barely stalked, M_1 from near its base; M_2 from well above middle of cell. Terminal tuft of male long, truncate, somewhat divided, much like the more generalized (typical) species of Marthula. Pattern distinctive, of heavy dark vein-lines, the one on

M_2 weaker, and fine lines in interspaces, the ordinary lines represented by a few pale dots.

Antiopha multilinea Schaus (Fig. 39)

A. multilinea Schs. Trans. Ent. Soc. Lond. 1901, 275, 11: 3.
Also *figured:* Seitz 144: i8.

The black is dominant over the brown, forming a dead wood effect. Common, Oct.-Apr. (see diagram, p. 245). Guatemala to S. Brazil.

Marthula Walker (*Crinodes* in part)

Larger species than the last, the abdomen and terminal tuft of *male* longer, but varying from species to species, the terminal tuft in our species simple or forked, without loose spatulate hairs. Front as smooth as Rosema, but with a slight central keel, and palpi upturned to middle of front; acc. cell moderate, about 1/3 overlapping cell, R_5 connate from its tip, M_1 from its base. Pattern usually of fine transverse lines, with subbasal and medial as well as the usual lines. (See Fig. 40)

Marthula rufescens Schaus

M. rufescens Schs. Ann. Mag. Nat. Hist. (8) vi, 576, 1910.
Not *figured.*

Brown; a darker shade before postmedial line; subterminal of a series of blackish shade-spots; hind wing brown in male and brown-tinted in female, unlike *M. quadrata.*

Dec. 24 (Bts.) Jan. 24 (Fried.) two females. Costa Rica (type), also a doubtful female seen from Guiana.

Crinodes Herrich-Schæffer

Head as in the last two genera; fore wing with fork of R_3 and R_4 very short, M_2 from middle of end of cell, but mdcv exceptionally oblique; Cu_2 arising from cell before R_1 (unusual in the family). Abdomen of male long and conical, Sphinx like, with a long loose terminal tuft (unlike the related genera, which have the tuft sheared off squarely or forked), female normal. A very distinctive genus, much like Tarsolepis in the Old World, but the latter has a silver pattern suggestive of Lepasta, and sometimes pectinate antennæ. The species are close, and probably best separated by the course of the t.p. line.

1. Postmedial line strong, excurved in fold, double, dark; black dash in discal fold accompanied by a distinct pale shade below it; scaling smooth. . . . . *besckei*

   Postmedial line when distinct not strongly excurved in fold, frequently fading out below. 2

2. Fore wing with slightly raised transverse striation, visible with grazing lighting, most distinct from end of cell well toward margin; postmedial line diffuse and distinct toward costa only, where it may have a faint continuous pale dividing shade. *striolata*

   Fore wing smooth-scaled, the dark postmedial area with faint striation in some specimens of ritsemæ. 3

3. Browner, postmedial and subterminal lines marked by mixed black and deep yellow dots, usually only toward costa; black streak beyond cell to near outer margin heavily dusted with deep yellow. . . . . *schausi*

   Grayer; postmedial line marked by paler yellowish points on veins (sometimes absent), the single narrow blackish line which is parallel to it on inner side more distinct than in schausi. *ritsemæ*

Crinodes besckei Hübner

Crino besckei Hbn. Samml. Exot. Schm. ii, 194: 1, 2 (♂ only) 1823.
Crino dissimilis Grt. Trans. Am. Ent. Soc. iii, 183, 1870.
Also *figured:* Biol. 92: 4 (as *ritsemæ*); Seitz 145: d1 ♂, b2 ♀.

June 5 (Fried.), Lancetilla, Honduras (Bts.). Mexico to Brazil. Specimens from west Mexico and Cuba are a distinct small race with base of hind wings much paler (*dissimilis*).

Crinodes ritsemæ Butler

Crino besckei Hbn. Samml. Exot. Schm. ii, 194: 3, 4, (♀ only) 1823.
Crinodes ritsemæ Btl. Ann. Mag. Nat. Hist. (5) ii, 172, 1878.
Also *figured:* Biol. 92: 7 (as *abscondens* Walker in error); Seitz 145: b3.

In this species the ren. is thick, erect, with a central black pupil, which occasionally almost fills it, the p.m. broad and blackish, more than half beyond the series of pale vein-dots and preceded by a second narrow line; in the North American *C. biedermanni,* the p.m. is fine, scalloped, its teeth meeting traces of the yellow dots, and in one of our specimens immediately followed by a brown band; the ren. connects with the pale costal stripe. (See Fig. 29)

May 24 (Fried.), a rubbed and nearly immaculate female, but apparently of this species. Lancetilla, Honduras (Bts.). Ranges to Brazil.

Crinodes schausi intermedia Draudt

[*Crinodes schausi* Roth., Nov. Zoöl. xxiv, 235, 1917; Seitz 145: c2.]
C. s. var. *intermedia* Ddt. Seitz. Macrolep. World, vi, 925, 145: d5, 1932.

Larger and much darker and warmer brown than ritsemæ (typical schausi not so); blackish markings more or less suffused with deep yellow dusting, especially band beyond cell; discal bar strongly oblique, linear, shaded with yellow dusting, not in a regular pale spot, hind wing deeper; the under side usually with a dark pm. shade running from opposite cell nearly to anal angle. A specimen from Venezuela has a more erect ren. but may be distinct (the st. spots being wholly dark, etc.).

Nov. 3, Feb. 3 (Bts.). Mexico to Southern Brazil.

Crinodes striolata Schaus

C. striolata Schs. Trans. Ent. Soc. Lond. 1901, 277.
C. s. var. *fuscipennis* Roth., Nov. Zoöl. xxiv, 235, 1917.
C. s. var. *insularis* Roth., Nov. Zoöl. xxiv, 235, 1917.

The moth varies in shade of color and distinctness of pattern, the t.p. being sometimes distinctly sinuous, and partly double toward costa, sometimes with almost all markings (except the pale base) obsolete. *Fuscipennis* was based on relatively plain specimens; var. *insularis*, if I have it named correctly, is more distinct and much like *C. ritsemæ*.

Common in first half of May (see diagram, p. 245). Costa Rica to Pernambuco and Peru; var. *fuscipennis* with the type, var. *insularis* in Venezuela and Trinidad.

Dasylophia Packard (*Hatima* Walker)

The three following genera are closely related, and probably directly ancestral to the Nystalea group; — except for the 3/5 pectinate antennæ they hardly differ from Lepasta, and *Proelymiotis lignicolor* is really a Dasylophia even in pattern. Third segment of palpus about 1/3 second (unlike Didugua), M_1 arising from base of acc. cell or free, R_5 at about half total length of acc. cell or before (unlike Betola).

Most of the species have the subterminal and adterminal lines rather close together, with the cells M_3 and Cu_1 more or less filled with black between them, sometimes forming ocelli.

Known larvæ on Leguminosæ, but *D. thyatiroides* also reported from Hickory. The few described larvæ smooth, with a slightly raised shining black subdorsal spot on the side of first segment of abdomen and a dorsal one on 8th.

1. Postmedial line distinct, running in a broad curve from near costa to Cu_2, then bent in and enclosing a black spot in fold... *guarana*
   Postmedial line when distinct erect or a little oblique out above M_3, — from Cu_1 to middle of fold straight and strongly oblique in, sometimes only indicated by a following brown bar or obsolescent....2
2. Males; antennæ broadly pectinate on basal 3/5; frenulum simple (*maxtla* not recognized)....3
   Females; antennæ simple or pectinate narrowly at base, frenulum multiple....4
3. Lighter, commonly with fine striation beyond postmedial line; typically with a black streak in cell and basal dash just below Cu....*terrena*
   Postmedial area more heavily suffused with red-brown; the whole effect darker....*xylinata*
4. Antennæ simple; ground suffused with black brown, leaving the basal area contrastingly pale; postmedial line fine when distinct or marked by dots on veins, retracted on veins M_1 and M_2, the area beyond it with two dark streaks to a cell....*terrena*
   Antennæ shortly pectinate at base; base of fore wing not contrastingly pale; postmedial diffuse, generally evenly excurved opposite cell, the streaks beyond it more diffuse and somewhat oblique when distinct....5
5. Pale, the only conspicuous marking a brown oblique dash along dorsal part of postmedial; tegulæ all of the pale color (with fine center line at most)....*maxtla*
   Heavily shaded with red-brown, somewhat defining the pale basal patch of D. terrena; tegulæ with inner half red-brown..*xylinata*

Dasylophia guarana Schaus (Fig. 42)

Oedemasia guarana Schs. Proc. Zoöl. Soc. 1892, 331.
Figured: Seitz 146: b5 ♂.

Female much larger and coarser, with the general appearance of *terrena* (146: d3) but the finer pattern of the male. I found only males in Guiana, but the present series are all female but one.

Flight scattering (see diagram, p. 245). Mexico to South Brazil, the southern (typical) specimens slightly variant.

Dasylophia terrena Schaus

Oedemasia terrena Schs. Proc. Zoöl. Soc. 1892, 331.
Notodonta dares Dr. Ann. Mag. Nat. Hist. (6) xiii, 356, 1894.
Figured: Seitz 146: d3 ♀.[1]

Male light wood brown, striate, one of the two specimens from B.C. Id. without the usual stronger streaks, and somewhat darker except for the outer margin. Female much larger and heavier, very distinct in the blackish shading on center of wings and inner half of tegulæ.

Females Nov. 22-Mar. 3; only two males: Jan. 10 (fresh), May 6 (rubbed). Mexico.

[Dasylophia xylinata Walker

Nystalea xylinata Wlk. List Lep. Ins. Br. Mus. xxxiii, 759, 1865.
Notodonta (?) *pythia* Dr. Ann. Mag. Nat. Hist. (6) xiii, 346, 1894.
Also *figured:* Biol. 90: 7 ♀, Seitz 146: c7 ♂, d1 ♀.

If the sexes are correctly associated the male of this is darker than *terrena*, though the female is lighter, but both agree in the less definite striation beyond the t.p. line.

All the specimens taken on Barro Colorado Id. are of the following, which I suspect is merely a color form.

Lancetilla, Tela, Honduras (Bts.). Mexico to Brazil.]

Dasylophia maxtla Schaus

Oedemasia maxtla Schs. Proc. Zoöl. Soc. Lond. 1892, 331.
Figured: Seitz 146: d2.

Very near the last; perhaps a pale color form.

Jan. 26-May 2. Mexico.

[1] The figure of *terrena* ♂ in the Biologia, 90:6, is much darker than *terrena* as determined in the National Museum and accepted here, and is the male credited to *xylinata* in Seitz.

Betola Schaus

Very near the last, though with M_1 arising farther out. Pattern homogeneous, similar to *Proclymiotis lignicolor*. Mixed gray, clay color and brown, the most conspicuous features four or five short oblique black-brown bars.

Betola aroata Schaus (Fig. 43)

B. aroata Schs. Trans. Ent. Soc. Lond. 1901, 290, 11: 6.
Also *figured:* Seitz 148: f2.

Male hind wing almost wholly translucent white, female shaded with fuscous.

Nov. 22-May 6. Also seen from Venezuela and Guiana; more southern records apparently belong to a related species.

Didugua Druce

Similar to Dasylophia; third segment of palpus much longer, more than half as long as second.

Didugua argentilinea Druce (Fig. 44)

D. argentilinea Dr. Biol. Centr. Am. Lep. Het. i, 483, 40: 13 ♀.
Also *figured:* Seitz 146: a5.

Wood brown, middle of wing darker, two triangular silver spots, sometimes connected; adterminal line fine, even and black.

In the closely related *D. leona* Dr. the adt. line is broken and the moth larger and darker.

Chief flight at end of Jan. (see diagram, p. 245). Southwest U. S. to Venezuela.

Lusura Walker (*Tifama* Walker)

No accessory cell; R_2 stalked beyond R_5, M_1 free, M_2 below middle of cell. Palpi beak-like, the second segment with a larger triangular tuft below, third short; antemedial line marked by a series of small raised tufts; pectinations of male antenna ending abruptly at 3/5. Hind tibia nearly smooth scaled. (See Fig. 45)

Larva smooth, with five fleshy cylindrical middorsal processes, grouped three and two (Stoll, Sepp).

A curious genus, perhaps derived from somewhere between Nystalea and Dasylophia; female much larger than male and differently marked.

Lusura altrix Stoll

Bombyx altrix Stoll in Cr. Pap. Exot. iv, 36, 307: E, 1782.
Also *figured:* Fld. Reise Novara Lep. 98: 6 ♂ (as *Chatognatha*); Seitz 154: a1.

Male with all-over pattern, with a contrasting yellow subapical patch at costa (not shown in Seitz' figure), and disc of hind wing white. Female dark brown, terminal area lighter; with black streaks in base of fold and through end of cell, and usually an irregular light terminal area; hind wing dark.

Feb. 3 ♂ (Bts.), Mar. 30 ♀ (Fried.). Guiana and Amazons.

The next two genera agree in having two-thirds pectinate antenna and long rather truncate fore wings with relatively small hind wings; they are probably somewhat related to Dasylophia, and the second apparently leads over into Rosema.

Lirimiris Walker

Antennæ broadly and stiffly pectinate to 2/3 in both sexes. Front with massive rough scaling, but no tufts or ridges, palpi hardly upturned to middle of front, 3 short; antennæ without distinct plume. Acc. cell rather long, M_1 beyond middle, R_5 stalked, M_2 at middle of cell or below; Sc of hind wing usually diverging from cell before middle.

1. Inner half of fore wing only slightly darker than costal half, costal edge contrastingly dark. 2
   Inner half of fore wing contrasting, dark brown, the boundary faintly deflected by reniform. . . . . *truncata*
2. Tip of abdomen contrasting, yellow in male, yellow or whitish in female. . . . . *auriflua*
   Tip of abdomen concolorous gray. . . . . *lignitecta*

Lirimiris lignitecta Walker (Fig. 46)

L. lignitecta Wlk. List Lep. Ins. Br. Mus. xxxii, 469, 1865.
Figured: Biol. 91: 20; Seitz 147: d5 ♂, e3 ♀.

Ground mottled in two shades of pale gray; ordinary spots large and faint; t. space dark-filled. Hind wing largely white.

May 24 (Fried.). Guerrero, Mexico to southern Brazil, the latter the slight race *arpi* Ddt.

Lirimiris auriflua Draudt

L. auriflua Ddt. in Seitz Macrolep. World vi, 943, 147: f2, 1932.

Averages a little smaller and paler, but differs definitely only in the contrasting pale tail.

May 22 (Fried.). Lancetilla, Honduras (Bts.). Guatemala, Costa Rica and Lino, Panama (Nat. Mus.). Peru and Brazil (types).

Lirimiris truncata Herrich-Schæffer

Drymonia truncata H.-S. Aussereur. Schm. 66, fig. 494, 1856.
Also *figured:* Seitz 147: f4 ♂, 3 ♀.

There is a fine pale double terminal line on all wings.

Nov. 22, Feb. 3, May 25. Ranges north to Mexico.

Canodia Guenée (with *Drastoma* Schaus)

Head smooth and palpi hardly exceeding front as in Rosema; fore wing long, with truncate apex and Cu_2 arising rather beyond R_1. Collar erect, ridge-like. Color dull olive, easily fading (unlike Rosema) to dull red-brown. Markings complete, with a basal as well as double ante- and postmedial lines, and a large reniform.

Canodia difformis Herrich-Schæffer

C. difformis H.-S. Samml. Aussereur. Schm. 67, fig. 132, 1854.
? *C. carmelitoides* Gn. Sp. Gen. Ins. Lep. Het. vi (Noct. ii) 378, 12: 8, 1852.
Also *figured:* Seitz 157: d5 ♂, 4 ♀.

In the original figures *carmelitoides* was figured with single ordinary lines and *difformis* with strongly double ones, but commonly, as in the present specimen, there are two strongly unequal lines. Possibly the names can be kept for slight northern and southern races.

Mar. 17 (A.M.N.H.). Ranges south to Brazil.

Phyllopalpia Draudt

Antennæ narrow, gradually tapering to a simple apex, as in the North American (and also Neotropical) Symmerista; acc. cell short, M_1 free, R_5 barely stalked; palpus with 3 half as long as 2. Pattern suggestive of *Lepasta maltha*. Probably related to Symmerista and rather ancestral to the Nystalea complex.

Phyllopalpia marcella Schaus

♀ *Antiopha marcella* Schs. Ann. Mag. Nat. Hist. (8) vii, 615, 1911.
♂ *Antiopha pittieri* Schs. Proc. U. S. Nat. Mus. lxv (7) 57, 1924.
♂ *Phyllopalpia triangulum* Draudt in Seitz Macrolep. World i, 929, 147: a4, 1932.

Clay color, with a large irregular black-brown V, edged above and before with shining cream white, and with minor marks; when fresh with some olive tint. Schaus thinks the name *triangulum* can be kept for a southern race, but if so the difference is slight.

Jan. 31, 1935, 1 ♀ (Bts.). Costa Rica (type *marcella*), Venezuela (type *pittieri*); Guatemala and Paraguay (U.S.N.M.) *P. triangulum* was described merely from "South America."

Peroara Schaus

Antennæ with pectinations very gradually lessening to a simple apex; palpus with 3 long, but nearly buried in the loose hair of 2; front with a medial keel-like tuft; abdomen without any tuft. Acc. cell short, but lying mostly beyond discal, M_1 arising beyond its middle, R_5 stalked, M_2 from well above middle of end of cell.

A rather isolated genus; the appearance and hairiness suggest North Temperate genera of the Notodonta group.

Peroara discovata Schaus (Fig. 47)

P. discovata Schs. Proc. U. S. Nat. Mus. lix, 385, 1922.
Not *figured* (resembles *P. sylvestris* and *caterina*, Seitz 148: g1, 2).

Ash gray; reniform a white comma with dark center; st. line conspicuous, waved, whitish, preceded by blackish separate wedges (united in *P. sylvestris*), which are conspicuous except opposite cell.

Apr. 29-May 2 (Fried.). Guatemala to Colombia. *P. sylvestris* ranges from Colombia to Pernambuco, *P. caterina* is in southern Brazil.

Apela Walker

Vestiture of front and palpi nearly smooth, as in Rosema, Canodia, etc., mid and hind tibiæ more or less hairy, the mid-tibia with sextufts in some species; male antenna simple, fasciculate. Fore wing broad, with a lobe and scale-tuft on middle of inner margin, longest in *A. neobule* and *acutidivisa*; R_5 long-stalked from the short acc. cell, M_1 arising

beyond middle, M_2 near upper angle of cell. Hind wing with Sc divergent from just beyond middle of cell. The species are brown or buff, with a fine oblique pm. line running to the tuft, and are superficially very close. As they are universally confused I give a key to all. The superficial key may fail, the genitalic key is safe for the males, and most can be separated by the shape of the 8th sternite. Besides the one or two cornuti used in the key, there is a group of fine detachable ones in all the species examined.

There is an additional undescribed species from southern Brazil intermediate between groups I and II, in coll. Françlemont.

Superficial key to species (mainly males)

1. Ordinary spots (orbicular and reniform) dark, distinct at least on upper side, fused below and enclosing a small brassy yellow spot; much of antemedial space and subterminal region near inner margin brassy, contrasting with the umber ground..... *lilacina*
   Ordinary spots separate when distinct, sometimes obsolete; no contrasting brassy areas..... 1½
1½. Antemedial line touching orbicular spot, white and fine; a definite triangular chestnut brown patch on outer two fifths of costa..... *picturata*
   Antemedial line separated by a distinct space from orbicular, only rarely marked with white; at most with a vague dark shade on outer part of costa..... 2
2. Pm. line followed immediately by a distinct olive line, edged in turn with pale (ground light, tuft long)..... *acutidivisa*
   Pm. line simple or followed immediately with pale; no green.... 3
3. Ground orange ochre, the pm. followed by pale and then by a second fine faint dark line, which is followed in the usual male by a pale shade; ordinary spots weak or obsolete in female. *neobule* (*divisa* ?)
   Ground brown, varying from leather color to deep umber; pm. line not double..... 4
4. Under side of hind wing red-brown, in male almost concolorous with upper side and formed of rough sex-scaling, in female somewhat paler; fore wing blunt and squarish..... *cataphœa*
   Under side of hind wing cream white, contrasting.[1]..... 5

[1] The characters from here on apply definitely only to the males, I have not associated the corresponding females except in Panama, where the female of *rufinsulæ* is much darker than of *divisula* or than its own male.

5. Fore wing with median area distinctly darkened, contrasting a little with antemedial area and outer third..... *divisula*
   Fore wing with ground even or generally darkened to costa.....6
6. Antemedial line rather even, excurved, extending almost straight across the submedian space.....7
   Antemedial line scalloped, deeply retracted at middle of submedial space, or reduced to black and white dots on veins.....8
   Antemedial line not traceable, or indicated by one or two very faint white dots; postmedial very faint, dark, followed by paler; wings blunt and squarish..... *asema*
7. Wings narrower, lobe at inner margin (including tuft) smaller, nearly isosceles; ground darker and duller; ante- and postmedial lines sometimes defined finely with white..... *archimma*
   Wings broader, lobe on inner margin stronger, very prominent, the basal side of tuft cut off almost at right angles to general line of margin; ground of male rather warmer brown, of female umber brown..... *rufinsulæ*
8. Postmedial line followed by a distinct *even* paler defining line or shade, not defined by white points, or with one or two toward costa only, antemedial usually complete..... *strigatula*[1]
   Postmedial line without a distinct following shade, but defined by a more or less complete set of mixed black and white points on veins; antemedial also mostly indicated by black and white points on veins..... *punctilla*

Synopsis of eighth sternites (male)

1. Terminal notch about as wide as the lobe on either side or narrower, rounded at bottom; base of 8th sternite with slightly extended angles only.....2
   Terminal notch much wider than the lobes on either side, which are often pointed, or else membranous, with a V-shaped notch; base of 8th sternite with a pair of long hollow extensions.....5
2. Notch much deeper than wide, ending in a deep pocket.... *asema*
   Notch about as deep as wide.....3
3. Side lobes squarely truncate.....4
   Side lobes symmetrically extended at middle in a blunt point. *neobule*
   Side lobes distinctly furthest extended at edges of notch, sloping back to sides (notch either rounded or V-shaped)..... *divisula*

[1] This may possibly be the male of *A. strigata* Mösch., described from two females.

4. Sides of notch convergent, notch smaller. . . . . *acutidivisa*
   Base of notch curved in a circle, notch larger. . . . . *lilacina*
5. Notch V-shaped with rounded bottom and chitinized free edge. . 6
   Notch with a sharp V-shaped bottom and convex nearly membranous edges. 7
   Notch with rounded concave sides as a whole, at the bottom extended with a chitinized thickening. . . . . *cataphœa*
6. Notch rather wider at mouth than deep, flaring. . . . . *archimma*
   Notch much deeper than wide at mouth. . . . . *rufinsulæ*
7. Base of notch simple or with a slight slit. . . . . *strigatula*
   Base of notch extended with a short slight keel. . . . . *punctilla*

Natural Key to Species (Primarily Genitalic)

1. Lower lobe of inner keel of valve in the form of a short transverse ridge; penis with a heavily chitinized outer plate; 8th sternite without tubular extensions at base, with a small rounded notch at apex (*Group I*). 2
   Lower lobe of inner keel of valve rudimentary, either a membranous flange or a small nodule, the upper lobe frequently large; penis not chitinized in outer side (except *A. rufinsulæ*); 8th sternite with a pair of tubular extensions of base, the apical notch large but chitinized and rounded at bottom (*Group II*). 6
   Lower lobe of inner keel of valve large and thin, erect; the upper lobe rudimentary or absent; penis with a small weak chitinization on outer side; 8th sternite with outer margin membranous or nearly so, of two convex halves, meeting in an acute angle; tubular extensions present. Uncus inflated (*Group III*). 8
2. Uncus thick at tip; species with rather distinctive patterns (see first key); upper lobe of valve triangular, half way between lower lobe and apex. 3
   Uncus thin at tip; plain brown species, with the usual lines and spots only, often inconspicuous; upper lobe of valve close to lower or absent. 5
3. Lower lobe of inner keel a third way from hinge to apex; penis with a moderate outer flange and acute cornutus. 4
   Lower lobe half way to apex; penis with a very large inflated outer flange and a rounded cornutus. . . . . *neobule*
4. Cornutus a regular rose-thorn, with expanded base; ventral side of uncus not expanded at base; moth buff with olive line.
   acutidivisa

Cornutus a mere nodule; ventral side of uncus distinctly expanded at base; moth brown and brassy. . . . . *lilacina*

5. Upper lobe of valve triangular, close to lower; penis with two cornuti and an outer spine. . . . . *asema*

Upper lobe of valve absent; penis with outer chitinization only, no cornuti. . . . . *divisula*

6. Uncus thin at base and broadly expanded at tip (square) as in Group III; tip of valve with a special terminal transverse keel, not quite reaching inner edge; both lobes of valve high and thin, parallel but offset from each other, the outer a high triangle, the basal weak and rounded; penis with two large, simple, lightly chitinized cornuti. . . . . *cataphœa*

Uncus broadly expanded below at base, with normal narrow tip; tip of valve rounded over, with the edge corresponding to the transverse ridge of the preceding, curving back and faintly joining the outer tooth of valve; lower tooth a small nodule, lying in front of a broad membranous flap that reaches to base of valve. 7

7. Penis lightly chitinized on outer side, the cornutus a very large terminal spine; outer lobe of valve sharply triangular. . *archimma*

Penis with a heavy outer chitinization, ending in a lateral spine; cornutus a rose thorn; outer lobeof valve rounded over. *rufinsulæ*

8. Uncus diamond-shaped; inner lobe of valve represented by the abrupt ending of a long membranous fold extending to base of valve, outer lobe obsolete. . . . . *strigatula*

Uncus hexagonal; inner lobe of valve a large oblique triangle, rounded at tip and concave on outer side, not connected to base; outer lobe represented by a distinct oblique chitinous ridge. *punctilla*

Group I

Apela neobule Druce

? *Apela divisa* Walker, List Lep. Ins. Br. Mus. v, 1093, 1855; Hmps. Fauna Br. India Moths i, 168, fig. 104 (♀ and venation).

Maschane neobule Dr. Ann. Mag. Nat. Hist. (7) xiii, 250, 1905.

Also *figured:* 154: c6 ♀, 5 ♂ (as *lilacina*).

Female with ordinary spots faint as a rule, and no shade beyond the faintly duplicated pm. line; male with a whitish shade toward costa and distinct orb. and ren, dark and close together, but no spot below the cell; inner marginal lobe very long and the wing shaded with fuscous about its base. (Fig. 19, male genitalia.)

I think this is the true *divisa* as figured by Hampson from Walker's type, but as the type is female and the name has usually been applied to a mixture of the brown species, I am not using the name.

Nov. 29, Jan. 8 (Bts.), Mar. 18 (Wood-A.M.N.H.), May 4-7 (Fried.), Lancetilla, Honduras (Bts.). Costa Rica (type). Further distribution unknown from confusion with other species, especially *A. divisula*. *A. divisa* was described from Nepal, in error.

[Apela picturata Dognin

A. picturata Dgn. Hét. nouv. Am. Sud. xii, 13, 1916.

The type in the U. S. National Museum shows a very distinct chocolate brown species with contrasting pure white lines; and long inner lobe on fore wing. Genitalia not examined.

St. Jean, Maroni, French Guiana.]

[Apela acutidivisa Rothschild

A. acutidivisa Roth., Nov. Zoöl. xxiv, 262, 6: 12, 1917.

Study based on two males from Moengo, Surinam and Mouth of R. Teffé, Upper Amazons, determined by Schaus. (Fig. 20, male genitalia). Described from French Guiana.]

[Apela lilacina Dognin

A. lilacina Dgn. Het. Nouv. Am. Sud. xxxii, 14, 1923.
(Not *A. lilacina* Seitz 154: c5, which I believe is male *neobule*).

Study based on specimens from Moengo, Surinam, and Remate de Malos, R. Javary, E. Peru, (Fig. 21, male genitalia) compared with Dognin's type from French Guiana.]

Apela divisula, new species

Apela divisa Seitz 154: 3 ♂, 4 ♀? (not *divisa* Walker).
A. neobule in part of U. S. National Museum.

Male genitalia as given in key and figure 22; mid tibia with some loose hair, without sex-scaling.

Light red-brown, the usual color for the genus; front of collar, head, including palpi, upper part of breast and fore legs a little warmer brown, under side otherwise pale. Upper edges of collar and tegulæ

and posterior tuft of thorax, also tuft of fore wing powdery, largely of mixed black and white scaling. Fore wing with median area somewhat darker, especially toward costa in female, antemedial area distinctly paler, often somewhat contrasting, outer third somewhat paler, more or less shaded with dark gray, somewhat less yellowish; tuft on inner margin long, but shorter than in *A. neobule*; lines fine, single, distinct; subbasal excurved and somewhat waved; antemedial evenly excurved to A, then abruptly offset in and vertical to inner margin, sometimes with black and white scales on veins; postmedial straight from apex to outer side of lobe on inner margin; blackish, conspicuous, the outer part sometimes with a coaly lustre (corresponding to the olive line of *A. acutidivisa*); ordinary spots close together, of somewhat blurred vertical ellipses, the ren. higher as usual; usually with a smaller horizontal ellipse (suborbicular) below cell, forming a triangle; two or three adterminal dots below middle of wing normally present. Fringe somewhat darker. Under side of fore wing a lighter reddish buff, with contrasting dark brown fringe, the hind wing cream, much paler. Female much like male, larger, duller.

Barro Colorado Id., C. Z., Panama, Oct. 25 to June 23; type and numerous paratypes in M. C. Z. and A.M.N.H., also deposited in Cornell University (see diagram, p. 163). Mackenzie and Tumatumari, British Guiana, Moengo, Surinam, Fyzabad, Trinidad, Mouth of R. Teffé, Codajos and Rio Tajapurú, Amazons, in Cornell University; also from Nova Bremen and Jaraguá, Santa Catherina, Brazil in Cornell and coll. Françlemont. Females from Manãos, Amazons, Brazil are put here doubtfully, but the females (4) from B.C. Id. may be trusted, the confusion species being apparently absent.

[Apela asema, new species

Similar to the preceding except for genitalic structures indicated above (fig. 23) and the following points: ground of head, thorax and fore wing evenly red-brown, without the warmer and darker shades; the powdery black and white areas at the same places but reduced, inconspicuous; fore wing without white costo-apical dots; basal line lost, t.a. of faint white dots on veins only; t.p. a fine whitish line, with a faint dark shade before it, strengthened on veins, and interrupted between; straight to outer edge of the anal lobe, which is strong, but wider than high. Under side like preceding; mid tibia with a mass of curving fine hair-scales, appearing considerably thickened.

Manãos, Brazil, Sept. 7-9, 1920, 1 male holotype in Cornell University collection.]

Group II

APELA RUFINSULÆ, new species

A. divisa of U. S. Nat. Mus. in large part. (Not *divisa* Wlk.)

Male genitalia as given in keys and figure 25, on the whole of generalized type, but the ventral base of the uncus the widest of any species studied, almost as wide as dorsal base, and the hollow basal extensions of the 8th sternite so curved on inner side as to enclose almost a perfect circle. Mid tibia with a fringe of stiff pale hairscales on inner side.

Red-brown, the head, front of breast, thorax, etc., concolorous with no black frosting, and only exceedingly fine white scale-tips; outer third rather paler beyond the pm. line, but antemedial region concolorous, the median area darkening noticeably to costa and apex slightly so. Basal and antemedial lines simple, dark, excurved and waved, nearly parallel, the am. retracted below A but not offset, running to base of lobe; pm. from apex to outer edge of lobe, continuous, dark, followed merely by a narrow pale shade, marked by 2 or 3 white dots on veins toward costa but with no costo-apical white dots. Two black adterminal dots in cells M_2 and M_3. Under side like *divisula*. Female similar to male, but much darker umber brown, shading into blackish, making the very fine white frosting more distinct.

La Venta, Anton, Panama, Jan. 24 (Bts.), holotype ♂; Barro Colorado Id., Panama, one male and numerous female paratypes, chief flight in Feb. (see diagram, p. 245). Holotype and paratypes in M. C. Z. Paratypes also in A.M.N.H. and C.U. Not recognized from elsewhere, but probably wide-spread under the name of "*divisa*."

[APELA ARCHIMMA Schaus (Fig. 48)

A. archimma Schs. Proc. U. S. Nat. Mus. lxxiii (19) 54, 1928.

Mr. Heinrich has kindly compared the male genitalia (fig. 26) with the type in the U. S. National Museum. Only one of my specimens has the white ante- and postmedial lines. The species varies a good deal in color, but is long-winged and usually has a velvety look. I have not recognized the female.

Guiana and Amazons (type).]

[Apela cataphæa, new species

Structures almost intermediate between Groups II and III (fig. 24), the high square uncus being unique, but similar to that of the latter. Under side of hind wing covered with sex-scaling, concolorous brown, unlike anything else in the genus; very woolly at base of cell; mid tibia somewhat thickened with shaggy hair, but less than in *asema*.

General appearance remarkably like *A. asema*. Fore wing squarish looking. Red brown, very even but with upper edge of tegulæ and disc of thorax as well as edge of wing-tuft strongly powdered black and white; head and thorax otherwise concolorous with whole of wing. Antemedial and subbasal line excurved and waved when visible, practically obsolete in type; pm. line as usual from apex to outer edge of lobe, reduced to black and white dots on veins; all three lines rather strong and blackish in male paratype. Under side hardly paler than upper, the fringe hardly darker. Female similar to male type, nearly immaculate; the under side of hind wing a little lighter, but very much darker than in the remaining species.

Tumatumari, British Guiana, June 29, 1927, (at light), (male type), June 28 (paratypes ♂ and ♀) in coll. Cornell University.]

Group III

[Apela strigatula, new species

This species and the following are very close, as shown by both appearance and genitalia, but are sharply separated on the different shaped uncus and lobes on the keel of the valve (fig. 27).

Red-brown, without any distinct contrasts of tint; the edge of collar and rear of thorax with white-tipped fuscous scales. Basal line irregular and incomplete, antemedial when complete regularly dentate and excurved, often reduced to black and white dots on the veins; postmedial straight, a clear dark line followed by a pale one, without white dots on veins, but frequently with two white dots just below costal margin; fringe hardly darker, under side as in divisula. Mid tibia with a broad brush of stiff hair-scales in under side, and an oblique mass of closely applied hair-scales on inner side. Female not certainly identified.

San Paulo, Olivença, Amazons, Feb. 20, 1920 (H. S. Parish) type; Iquitos, Peru, Mouth of R. Teffe, Matura, below Codajos, east of Fonte Boa, and Manãos, Amazons, Brazil; Tumatumari, British

Guiana, all paratypes male in Cornell University. The Codajos specimen is very pale but has normal genitalia.]

[Apela punctilla, new species

Possibly *A. strigata* Mösch. Verh. z.-b. Ges. Wien xxvii, 683, 10: 41, 1878.

Genitalia (fig. 28) exactly like the preceding, except that the expansion of the uncus is rounded-hexagonal, with rounded apex, tapering base, and parallel vertical sides; outer lobe of valve a distinct long-oblique chitinized ridge; inner lobe undercut on distal side, sharply cut off at base, higher than wide, and not connected with base of valve; edges of lobes of 8th sternite fused for a short distance at base in a chitinized spur, showing in the intact specimen as a short ridge.

Moth brown, almost identical with the preceding; except for the series of white points along the pm. line in all specimens examined. Tibia apparently as in the preceding.

Mackenzie, British Guiana, June 21-24, 1927, type and several paratypes male; Tumatumari, B. G. June 28, 1 paratype.]

Tribe HETEROCAMPINI

This type has only been recognized in the North American fauna, but is present in South America where even the typical genus (Disphragis-Heterocampa) is strongly developed, and also invades the Palæarctic. Fentonia as represented there is commonly associated with our "*F.*" *marthesia*, a highly specialized form, but the larva (Marumo, Jour. Coll. Agr. I. Univ. Tokyo, vi, 314, 23: 27, 1920) is obviously very near Dicentria and Schizura. Stauropus is also by the larval stemapods unquestionably a Heterocampin, but Egonocia (Desmeocræra), which looks like Heterocampa, has a primitive Notodontine larva. By the larva the European Exæreta, Hoplitis, Pterostoma, Lophopteryx and possibly Spatalia should also be included.

The genera may be discussed in four arbitrary groups, though knowledge of the larvæ will certainly result in a different arrangement:

Dicentria: A small scale-tuft at middle of inner margin (except the North American Schizura); acc. cell usually rather short, M_1 from well before its middle; R_5 frequently stalked from apex; larva with humps topped with tufts of bristles (Dicentria, Schizura) or transverse ridges (Naprepa).

Hyparpax: Wings simple, wide and rounded, vestiture fluffy; antenna pectinate almost to apex; tongue weak; larva (Hyparpax) as in the preceding.

Disphragis (Heterocampa): Antenna pectinate to half or two-thirds, ending abruptly; acc. cell usually reaching half way to apex, with M_1 arising from its middle and R_5 near its tip; larva as before or smooth with baby larva only spined; tongue generally strong.

Rifargia: Similar, antenna simple, fasciculate; larva unknown.

Group I

Dicentria Herrich-Schæffer (*Ianassa* Walker)

Pectinations of male antennæ ending just beyond middle; head with loose hair on vertex; fore wing with acc. cell typically reaching about 1/3 way to apex; tending to be reduced, in the present specimen reduced to a minute trace at origin of M_1; R_5 then stalked beyond R_2; Hind wing with Sc and R well separated along cell, gradually diverging before end of cell.

Larva in *D. lignicolor* with a strong bristly hump on 1st segment of abdomen as well as thorax and 8th segment, the thorax contrasting green, in the present species with enlarged peg-like spines (see the species).

Dicentria violascens Herrich-Schæffer (Fig. 49)

Oligocentria violascens H.-S. Samml. Aussereur. Schm. 11, fig. 385, 1885.
Rifargia brunneipennis Kaye, Proc. Zoöl. Soc. 1922, 992, 1: 11.
Also *figured:* Biol. 91: 11 ♂, 12 ♀ (as *Phya phraortes*); Seitz 149: c4 ♂.

Strongly dimorphic, with about the coloring of the North American *Schizura concinna,* which the larva also resembles. Male light wood brown, strongly streaked, the anal black and white spot weak; female deep purple brown, with the anal spot contrasting. I found the species common in Guiana, but every male was rubbed.

Larva stippled, black on yellow, with red subdorsal tubercles, bearing thick black-tipped pegs; large and forked on first segment of abdomen, paired on 2 to 6, the one on 5 large and on 6 small, then a high pair on 8. Head cream and black, legs red.

Feb. 21 (Fried.), 1 ♀. Mexico to Amazons.

Astapa Dognin

Like the preceding, the wings broad and outer margin of fore wing sharply bent at M_3. For some unknown reason the Lep. Cat. separates this from Dicentria by fifty pages.

Astapa viridifusca Schaus

Odontosia (?) *viridifusca* Schs. Proc. U. S. Nat. Mus. xxix, 278, 1906; Seitz Macrolep. World vi, 1018, 1933.
Not *figured.*

Shaded dark olive and deep red-brown, with a contrasting white dot above Cu_2 at margin; ordinary lines double, dark, lighter-filled, not contrasting. Hind wing blackish.

Dec. 23, 1934 (Bts.). 1 ♀. British Guiana (type).

Naprepa Walker

Similar to Dicentria; the acc. cell relatively shorter. Very large species, expanding from 60 mm. up; male antennæ merely fasciculate, vertex without a tuft; fore wing with outer margin scalloped; R_5 generally stalked; M_1 well before middle of acc. cell; hind wing with Sc and R joined by a strong cross-vein, but well separated, and diverging gradually from middle of cell. Larva, see the species.

Naprepa houla Dyar

N. houla Dy. Proc. U. S. Nat. Mus. xxxviii, 257, 1911.
N. fusconubilata Roth., Nov. Zoöl. xxiv, 231, 5: 7, 1917.
Also *figured:* Seitz 154: e3.

Fore wing with ground evenly dark brown, with deadwood pattern; pm. black, bent in a series of extremely deep loops opposite cell, giving a striate effect. Expanse over 100 mm.

Larva in U. S. Nat. Mus., smooth except light raised transverse ridges on abdominal segments 1, 6, 8, (suggesting Raphia), these ridges evenly curved, from front of segment on sides to back on dorsum, the first two red, defined with white behind, the third black and defined with white in front; also marked with large ocelli with red centers and fine brown rings: a lateral series in thorax, weak on 1st segment of abdomen, three on second, a transverse series with a lateral one behind

on each of next three segments and 3 each on 6 and 7, besides one on each leg plate. Described from an inflation. The ground color now buff, doubtless green in life.

May 22, 1935 (Fried.), 1 ♀. Mexico to Venezuela.

Group II

KALKOMA Schaus

Antennæ plumose, head fluffy, palpi rather short, with rudimentary tongue, even weaker than in Hyparpax, legs fluffy, with fore tarsi tufted on outer side, the whole effect strongly Lymantriid. Fore wing with long acc. cell, but M_1 arising near its base; hind wing with costa strongly arched, and even R along cell strongly arched, parallel to Sc.

This genus is more extensive than indicated by Draudt etc., and must include "*Salluca*" *psittica*, *ruptilinea*, *virens* and *psitticula*. The following species is very small; all the other species seen except *pylaon* and *virens* differ in having a triple postmedial line; the type *virens* shows black beyond the t.p. and a black spot at base of cell; *pylaon* is much larger, with black on st. line at both margins. I have seen only one female of this genus, the type of *K. psittica* Schs.

KALKOMA MUSCOSULA, new species (Fig. 50)

Pale gray-green, the color on most of fore wing made up of a mixture of olive, white and a few black scales. Head white, tinted with pale olive; the front and lower half of antennal tuft more solidly pale olive; shaft of antennæ light brown; palpi white, with a broad black stripe on outer side, running over onto the upper side on second segment, but not on third. Fore legs white and pale olive with a broad band on front, shading from red brown on femur and tibia to black-brown on tarsus; under side and mid and hind legs buff. Abdomen mixed olive and light brown above, light buff below (easily becoming greasy). Thorax above with red-brown scales on upper half, partly white-tipped, base white, disc with a band of scales in front with blackish bases. Fore wing lighter toward costa (with more white scales). Ordinary lines darker, grayish; subbasal of a few gray dots, white-filled at costa; antemedial double, broken, waved, somewhat oblique to inner margin; postmedial double, waved, offset out on costa, incurved at cell and fold, somewhat excurved between, white-filled above

inner margin; median simple, dark, starting directly below first spot of pm. line below costa, then not offset but otherwise parallel to pm. to inner margin; (not appearing like a third line of postmedial as in some other species). St. of a couple of dark shades at costa and inner margin, followed by white spots; adt. fine, blackish, irregularly doubly dentate between veins and broken, reduced at costa to a single dot in R_3. Ante- and postmedial lines each marked by two contrasting black dots on costa. Hind wing light red-brown, somewhat paler at base. Expanse 32 mm., being the smallest species of the genus.

Barro Colorado Id., Panama, type Nov. 8, 1934 (Bates) and numerous paratypes, Oct. to June (see diagram, p. 245). Female unknown. The National Museum also has this species from Panama, and a male, apparently identical, from the Rio Xingú, Brazil.

Group III

Malocampa Schaus

Antenna pectinate only to 2/3; fore wing with M_1 arising from acc. cell near middle; R_2 and R_5 free at tip; M_2 high; hind wing with Sc diverging sharply from cell far before end. A slightly heterogeneous genus, intermediate between the Dicentria group and the Heterocampa group. Malocampa leans toward Group IV, the following Farigia is nearer to Disphragis.

1. Fore wing gray with a blackish patch over end of cell, and ordinary lines more or less marked with contrasting black dots; the subterminal series alternating with the terminal. . . . . *punctata*

   Fore wing dull gray without conspicuous light or dark markings. *Disphragis satis* and *matralis*

   Fore wing whitish, the markings and disc of thorax dark brown, contrasting, but tegulæ whitish. . . . . *puella*

   Fore wing light gray brown with whitish anal patch. . . . . *sida*

Malocampa punctata illimis Draudt

[*Bombyx punctata* Cr. Pap. Exot. iv, 36, 307: F, 1782.]
[*Malocampa punctata* Schs. Ann. Carnegie Mus. xv, 4: 19, 1923.]
[*Bombyx ziliante* Stoll in Cr. Pap. Exot. iv, 191, 384: C, 1782.]
[*Bombyx bifurcata* Sepp, Surin. Vlind. i, 33, 13, 1830 (with *larva* and *pupa*).]
M. p. form *illimis* Ddt. in Seitz Macrolep. World vi, 982, 151: b6, 1932.

All the specimens are of the race or form *illimis*, which is much smaller and the ground lighter than in typical specimens from Guiana.

Larva of *M. punctata* (Sepp) with high humps on first and 8th segments of abdomen, each bearing a pair of bristles (as in *Schizura unicornis* from the U. S.); green with a brown saddle marking, extending far down on sides of 3 and 6, where it ends in white spots. On "melkhoutboom."

Feb. 3 (Bts.), Mar. 2, 27, Apr. 3 (Fried.). Described from Mexico. The type form ranges from Surinam to southern Brazil at least.

Malocampa sida Schaus

Blera sida Schs. Proc. Zoöl. Soc. 1892, 333.
M. sidoides Schs. Trans. Ent. Soc. Lond. 1901, 208.
M. canescens Dgn. Ann. Soc. Ent. Belge lii, 171, 1908.

The synonymy is according to Schaus. The type of *canescens* is illegible, but the placing is reasonable.

Jan. 24 (Fried.), Feb. 6 (Bts.). Cuba and Mexico to southern Brazil and Paraguay.

Malocampa puella Dyar (Fig 51)

M. puella Dy. Proc. Ent. Soc. Wash. ix, 45, 1908.
Figured: Seitz 151: c6.

After studying the material in the U. S. Nat. Mus. I should separate the species of the *puella* group as follows:

1. Veins whitish in postmedial region, cut with blackish normally contrasting ..... *argentata*
   Veins concolorous 2
2. Blackish border of inner margin broadening more or less at middle, normally forming a conspicuous patch, which in typical puella reaches up to a median dash in fold 3
   Blackish on inner margin most emphasized at anal angle, never broad 4
3. Ground grayer; with ordinary lines more or less distinctly pale; under side of hind wing with border dark gray, strongly contrasting, and frequently reaching nearly or quite in to end of cell. (South America) ..... *piratica*
   Ground almost white, the usual lines not distinctly pale; under side of hind wing with border pale gray, hardly reaching half way in to end of cell. (Central America) ..... *puella*

4. Light gray, with at least the narrow reniform and postmedial line contrasting white..... *albolineata*
Practically white, with no paler contrasts..... *bolivari*

I am inclined to consider *puella* merely a northern race of *piratica*.

Jan. 4-Feb. 3 (Bts.), Lancetilla, Honduras (Bts.). Mexico to Venezuela, replaced by *piratica* Schs. in Guiana to Brazil.

Malocampa puella, ab. mexicana Draudt

M. albolineata form *mexicana* Ddt. in Seitz Macrolep. World vi, 983, 151: d2, 1932.

Blackish spot on middle of inner margin rudimentary or absent. I believe this is a form of *puella* rather than *albolineata* if the original figure is at all accurate.

Feb. 27 (Fried.), 1 ♀, transitional. Described from Mexico.

Farigia Schaus

Intermediate between Malocampa and Disphragis. M_1 arising near base of acc. cell; wings more or less marked with green; M_2 arising only a little above middle of cell; hind wing with Sc parallel to cell almost to apex, then abruptly diverging. (See Fig. 52)

Farigia pallida Schaus

Lophodonta (?) *pallida* Schs. Proc. Zoöl. Soc. 1894, 242.
Not *figured.*

♂ Gray, shaded with green, especially on ordinary lines, which are inconspicuous; thorax and a pm. spot on f.w. contrastingly whitish. ♀ with outer third mostly white, but heavily gray shaded beyond pm. line except opposite cell; base shaded and mottled with gray and lines filled with green more distinctly than in male. *F. catherinæ* Dgn. is similar, but the male hind wing is white.

Nov. 24, Dec. 7, 30, 3 ♂'s (Bts.); June 17 (Fried.). Guatemala to southern Brazil.

Disphragis Hübner (*Heterocampa* Doubleday, *Seirodonta* Grote and Robinson, *Cecrita* Walker, etc.)

Moth not always distinguishable from *Malocampa*, frequently but not always with straighter costa of hind wing, without the fringe of

long hair-scales. Larva smooth in last stage, with anal legs lengthened and raised, sometimes almost forming stemapods; first stage typically with black spines, the ones on prothorax often antler-like. The species with broad fringed costa like Malocampa usually have more or less green coloring.

I am placing *gelduba* here, following Draudt. While the male antenna is almost simple, it still shows rudiments of pectinations, and they stop rather abruptly toward the middle of the antenna. The pattern is also perfectly "Heterocampine" and not at all like normal species of Rifargia.

Males

1. Hind wing dominantly white; tufts on meso- and metathorax and first segment of abdomen massive, formed of curled, more or less metallic scales; ground of fore wing usually shaded with green . 2
   Hind wing black brown, as in female; tufts small and fine, — the one on first segment of abdomen a little enlarged, but formed of fine hair-scales 7
2. Fore wing fuscous, without green tint; hind wing almost wholly cream white, except above R 3
   Fore wing marked with green (fading to a dull dirty yellow) either broadly, or reduced to shades costo-apically and in cell M_3, etc.; hind wing heavily shaded with fuscous toward border, at least along veins 4
3. Evenly gray, as a rule, without costo-apical spot; a black dash in middle of cell Cu_1 and in base of fold, fine lunate reniform etc.; antennæ pectinate . . . . . *daona*
   Blackish as a rule; with a contrasting cream costo-apical spot, a small ocellate st. spot in cell M_3 and black dot in submedian; ren. short, b.d. obsolete . . . . . *gelduba*
4. Fore wing with anal angle lobed and tufted, inner margin sinuate, with long hair-scales antemedially; pm. finely white at anal angle only; cell M_2 heavily and contrastingly shaded with brown (or with very little black) the pm. line weak and visible mainly on veins; hind wing with the dense dark scaling extending down to M_1 . . . . . *lama*
   Fore wing with anal lobe slight or absent, — if present at all cell M_2 is heavily shaded and striate with gray and blackish, the pm. is double, black and fairly complete, and st. area with brown. Hind wing with dense scaling only costally, cell R being whitish. 5

5. Fore wing with a white antemedial spot at inner margin, preceded by a yellow (green?) over a black streak (not seen)....*lopodites*
   No antemedial white or black streak on inner margin.....6
6. Anal angle slightly lobed and inner margin slightly sinuate, a fine white preanal crescent as in *D. lama*, but cell M_2 largely gray, crossed by black bars, pm. line black, and hind wing whitish to R, and even above R with pale postmedial scaling.....*perplexa*
   Anal angle not lobed; white in pm. line located costally and along veins when present, not at anal angle; green areas slight and dull. *baracoana*[1]
7. Ground green, the ordinary lines more or less filled with dull flesh color, or if obscure, with reddish spots accompanying st. line. *biundata*[2]
   Ground grayish, or dull red-brown, the filling of lines and terminal area green and contrasting.....*livida*
   Without conspicuous or extended green.....8
8. Large, fore wing above about half blackish and half pearl gray (cream in female), forming a striking pattern.....*tharis*
   Moderate sized; not contrastingly of two colors; discal mark commonly a double black dot.....9
9. Shaded with whitish, pinkish buff, red brown and blackish, giving a general effect of oblique shades.....*notabilis*
   Rather evenly dull brownish or smoky gray.....10
10. Markings blurred, mainly formed of the ordinary lines; (female antennæ pectinate).....11
    Fore wing with dark streaks on veins, those on R_5 and M_1 connected by oblique streaks to costa; inner margin with a pattern of oblique darker brown and white markings, the upper edge of tegulæ whitish; female antenna simple.....*ligneata*
11. Thorax with a high divided blackish tuft on disc; fore wing smooth looking, only the black lower d.d. and a smoky and whitish spot at anal angle conspicuous.....*matralis*
    Thorax with tufting low and normal, with no contrasts; fore wing with all pattern elements obvious, the two discal dots subequal. *satis*

[1] Male of *D. altilis* is likely to run out here, perhaps distinguished by a green terminal area as in female; also *D. tuna* Schaus, which is buff and brown (green?) with black basal dash, dash in discal fold and subterminal spot toward inner margin. Hind wing dark.

[2] The green is very dull and fugitive; *D. vivida* is very similar, but with brighter green ground, and the st. marked by a conspicuous whitish patch instead of blackish dots.

Females

1. Fore wing green or heavily marked with green, occasionally with most of the normally green area covered with a white postmedial patch.....2

   Fore wing with at most a few green spots subterminally.....4

2. Ground rather broadly green (frequently dull and somewhat mottled, and very fugitive).....*biundata*[1]

   Ground grayish or brownish, the green filling the ordinary markings, and contrasting.....*livida*

   Ground shading from brown into green, or with the postmedial green replaced with whitish.....3

3. Postmedial area covered with a large whitish triangle...*baracoana*

   Postmedial area light green, contrasting with the darker and largely brown base.[2].....*perplexa*

4. Fore wing with a black dash in middle of cell Cu_1, normally connected with the discal bar and the lower spots of the inner st. line to form a loop.....5

   No black dash in cell Cu_1, sometimes a black line on the vein. *go to alternative* 8 *of male key*

5. Outer and inner st. lines (true st. and adt.) confused above, there being an oblique series of black dashes from apex to discal fold; pm. portion of cell M_3 largely filled with a semicircular (green) patch, which forms the lower end of a large crescentic or somewhat spiral postmedial marking, the black st. dot in this cell normally wedge-like.....*gelduba*

   Outer and inner st. lines separate to costa, the wedge-like st. spots accompanying the inner st. line so far as present; cell M_3 bisected by the well-marked pm. line, bicolored as a rule, not forming part of a spiral or crescentic marking.....6

6. Terminal area filled with green, except at costa where there is a green adterminal spot; cell M_3 with outer half green, the basal half dark.....*altilis*

   St. and t. areas all gray, or brown at costa; outer half of area in M_3 redder than basal half.....*daona*

[1] See note to male, above.

[2] *D. lama*, whose female is unknown to me, will doubtless also run out here.

Group I. Sexes unlike; male antennæ serrate, female simple

DISPHRAGIS GELDUBA Schaus

Rifargia gelduba Schs. Proc. Zoöl. Soc. 1892, 339.
Figured: Biol. 92: 3 ♀; Seitz 150: d5 ♂, 4 ♀.

Only two males taken; female common (see diagram, p. 245). Described from Mexico. Represented by *D. phasma* in Brazil.

Group II. Sexes unlike, male antennæ pectinate, female simple

DISPHRAGIS DAONA Druce

Heterocampa daona Dr., Ann. Mag. Nat. Hist. (6) xii, 357, 1894.
Figured: Biol. 90: 20 ♂; Seitz 150: d3 ♂ (var. *suavis*), 4 ♀.
Heterocampa androdora Dyar, Proc. U. S. Nat. Mus. xxxviii, 256, 1910.
D. daona, f. *suavis* Ddt. in Seitz, Macrolep. World vi, 970, 150: d3, 1932.
? *Heterocampa cubana* Grote, Proc. Ent. Soc. Phil. v, 252, 4: 7 ♀, 1865.
? *H. surinamensis* Msch. Verh. z.-b. Ges. Wien xxvii, 686, 10: 44 ♂, 1887.

Some of the names may represent slight races, but I think they are more probably merely color forms.

La Venta, Anton, Jan. 23 (Bts.). Ranges to Mexico, Cuba and the Guianas.

DISPHRAGIS ALTILIS Schaus

Heterocampa altilis Schs. Ann. Mag. Nat. Hist (8) vii, 272, 1911.
Not *figured.*

Perhaps an extreme form of the last, with which it agrees in pattern, though not in coloring.

Mar. 27 (Fried.), ♀. Type a female from Costa Rica.

Group III. Sexes unlike; antennæ pectinate, wider in male

DISPHRAGIS LAMA Schaus (Fig. 54)

D. lama Schs. Proc. U. S. Nat. Mus. xxix, 249, 1906.
Not *figured.*

The broad wings strongly lobed at the anal angle are distinctive; hind wing with costa very strongly arched, with very long hair, Sc touching cell only at a point at middle, then strongly divergent; R and

M_1 strongly stalked. I do not know the female. When fresh the moth shows no strong contrasts, but a beautiful velvety effect. *D. subalbida*, from southern Brazil, is related but less extreme in wing form.

Common (see diagram, p. 245). Described from Guiana.

Disphragis perplexa Schaus

D. perplexa Schs. Ann. Mag. Nat. Hist. (8) vii, 276, 1911.
Figured: Seitz 150: k2 ♀ (hardly recognizable).

Male easily distinguished by the small anal lobe and fore wing shading from brown into green; female much like *baracoana*, but with blackish st. spots in st. area and submedian fold, the former sometimes ocellate with whitish, while *baracoana* has the st. line not emphasized there.

The commonest Disphragis (see diagram, p. 245). Ranges to Mexico.

Disphragis baracoana Schaus

♀ *Heterocampa baracoana* Schs. Trans. Am. Ent. Soc. xxx, 145, 1904.
♂ *Heterocampa habilis* Schs. Proc. U. S. Nat. Mus. xxix, 250, 1906.
Figured: Seitz 151: a3 ♂ (unrecognizable), 4 ♀.

The male is a variable mixture of dull olive and dull smoky, darkening to a blackish shade or patch over end of cell, and with all the pattern distinct but not contrasting; the female usually has a contrasting white area beyond cell, but if this is green it can be separated from *perplexa* by the more wedge-like st. spots above inner margin and from *edwardsi* (*masta, muscosa*) by the pectinate antennæ.

Dec. 5 to Feb. 22. Mexico to Guiana (C.U.) and Brazil.

Group IV. Sexes similar; female antenna simple

Disphragis biundata Walker

Heterocampa biundata Wlk. List Lep. Ins. Br. Mus. v, 1025, 1855; Pack. Mem. Nat. Acad. Sci. vii (Monog. Bomb. Moths i) 235, 5: 4 ♂, 5 ♀, 32: 1, 2, 3, 4 (larva) — with full life history and bibliography.
Stauropus viridescens Wlk. List Lep. Ins. Br. Mus. xxxii, 416, 1865.
Cecrita v. Biol. i, 234.
(Not *Cecrita biundata* of Biologia, which is *D. obliqua* Pack., a member of Group II).

For the large North American Bibliography (missed by the Lep. Cat.) see Packard, l.c. The species is a minor pest in the North, associated with *D. guttivitta*, and part of the large economic literature of the latter should be credited here.

The green color of this species is particularly fugitive, and is lost in the five Central American specimens at hand. Tropical specimens are generally smaller and more mottled than those from the north. Larva green, with a large irregular dorsal reddish or reddish-edged patch, or with pale dorsal patch and brown on sides, or occasionally all green and white; first stage with antlers on prothorax, but body unarmed. A general feeder on soft-leaved trees.

Jan. 26 (Bts.), La Venta, Anton, Jan. 23 (Bts.). Chiriqui (Lutz); Lancetilla, Honduras (Bts.). Southern Canada to southern Brazil.

Disphragis ligneata Walker

Etobesa ligneata Wlk. List Lep. Ins. Br. Mus. xxxii, 471, 1865.
Heterocampa aconthea Druce, Biol. Centr. Am. Lep. Het. ii, 458, 90: 24, 1898.
Also *figured:* Seitz 150: g2 ♂, 4 ♀.

Jan. 27, Feb. 3 (Bts.), Apr. 24 (Fried.). Ranges north to Mexico.

Disphragis notabilis Schaus (Fig. 53)

Heterocampa notabilis Schs. Proc. U. S. Nat. Mus. xxix, 253, 1906.
Figured: Seitz 150: g3.

The coloring of Seitz' figure is good, but the markings are really much crisper.

Flight scattering, Dec. to Apr. Bates got a heavy flight at Lancetilla, Honduras, the end of April. Ranges to Guiana and Peru.

Group V. Antennæ pectinate in both sexes, broader in male, sexes similar

Disphragis livida Schaus

Heterocampa livida Schs. Ann. Mag. Nat. Hist. (8) vii, 274, 1911.
Figured: Seitz 150: k4 ♂, 5 ♀.

Female with green markings much bluer than male, in Seitz' figure and in the Nat. Mus., but this difference is likely to disappear in carelessly relaxed specimens. Female antenna pectinate.

Dec. 5 (Bts.). Lancetilla, Honduras, (Bts.). Costa Rica.

Disphragis tharis Stoll

Bombyx tharis Stoll in Cr. Pap. Exot. iv, 38, 308: D, 1787.
Heterocampa læca Schs. Proc. Zoöl. Soc. 1892, 333; Biol. 91: 2; Trans. Ent. Soc. Lond. 1901, 303.
D. tharis form *livescens* Ddt. in Seitz, Macrolep. World, vi, 973, 150: f4, 1932. Also *figured:* Seitz 150: f3 ♂, 2 ♀.

The variety *livescens* has the black pattern more broken up, and in particular has much of the ordinary lines represented by paired black dots. It was described from southern Brazil, where the type also occurs.

Chief flight apparently in June (see diagram, p. 245). Mexico to southern Brazil. The true flight time may be later, as no systematic collecting has been done in July and August.

The two following species are placed by Schaus in Malocampa. I transfer them to Disphragis, as they appear to be close relatives of *notabilis* and *mephitis,* and no tangible difference is known in the imago.

Disphragis satis Druce

Heterocampa satis Dr. Biol. Centr. Am. Lep. Het. ii, 457, 1898. (n.n.)
Heterocampa punctata Dr. Biol. Centr. Am. Lep. Het. i, 238, 1887.
(not *Bombyx punctata* Cr., which is a *Malocampa*).

Probably for technical reasons I should go back to the original name of *punctata,* but *satis* is now in use, and in case this species should turn out to be really a Malocampa, or the genera be combined, it would be necessary to revive it.

Jan. 4-Mar. 18 (Bts., Fried., A.M.N.H.). Ranges north to Mexico.

Disphragis matralis Schaus

Malocampa matralis Schs. Ann. Mag. Nat. Hist. (8) vii, 617, 1911.
Not *figured.*

A very close match to *D. mephitis,* but with less crisp markings, and distinct from all the related species in the high blackish thoracic tuft. The lower discal dot is much enlarged as in *D. mephitis.*

Dec. 7 to Feb. 20, Lancetilla, Honduras. Costa Rica.

Talmeca Schaus

Slender, fore wing oblong; acc. cell shorter and broader than in the preceding, typically about a third or half as wide as an interspace; vestiture loose, more hairy than usual, especially on tegulæ and palpi.

Male antennæ pectinate on basal ¾, rather abruptly decreasing to a simple apex. Frequently with R_5 stalked (varying within the species), or with M_3 and Cu_1 of hind wing stalked (separate in the present species). Anal tuft very long and bifurcate in male, short, but slightly bifurcate in female.

1. Ground dull rose and green; a red discal lunule..... *consociata*
   Ground clay, dusted with light rose; a black discal dot, occasionally obsolete..... *lunulata*

Talmeca consociata Schaus

T. consociata Schs. Proc. U. S. Nat. Mus. xxix, 264, 1906.
Boriza povera Schs. Proc. U. S. Nat. Mus. xxix, 264, 1906.
Not *figured.*

Fore wing dull rose, the usual markings more or less punctiform, deeper rose (ren. and st.) and blackish (am. and pm.), with three olive green stripes, on costa toward base, in outer part of cell and along fold; blackish shades mainly beyond the pm. opposite cell, and before it below cell. Terminal dots black and white, contrasting. Hind wing fuscous.

Oct. 30, 1934 (Bts.), 1 ♀. Described from French Guiana (*consociata*) and British Guiana (*povera*), the type of the latter almost illegible, but I think this.

Talmeca lunulata Dognin

T. lunulata Dgn. Het. Nouv. Am. Sud. ii, 34, 1911.
Not *figured.*

Pinkish gray; dusted and streaked with fuscous, the markings much broken, more or less picked out with fuscous scaling, an oblique am. bar at costa most distinct. Terminal dots black.

Dec. 6, 7, Jan. 29 ♀ (Bts.). Described from French Guiana.

A third, perhaps undescribed species is represented by a single female.

Group IV

Rifargia Walker

Similar to Disphragis, but with simple fasciculate antennæ; costa of hind wing arched and fringed; accessory cell reaching half way to apex, with M_1 from its middle, and R_2 and R_5 free. Hind wing with Sc

and R connected at a point near middle and then rapidly diverging (except in *R. felderi*); palpus upturned to near middle of front, third segment short; front rough above it; scape without tuft above; spurs of hind tibiæ short, a little longer in *R. bianca*.

1. Ground pale gray or white.....2
   Ground gray-brown, with a large rather triangular whitish area. *apella*
   Ground blackish; male with subapical spot; female with large, pale crescentic patch.....*Disphragis gelduba*
2. Postmedial line single, black, contrasting, the basal line oblique out, also black and contrasting; marginal area heavily shaded with blackish.....*bianca*
   Postmedial line double, not contrasting, the antemedial and usually basal line also, similar.....3
3. Subterminal area, except for adterminal line, merely shaded with brown and blackish; basal line single, confused.....*felderi*
   Subterminal area with a series of black spots or wedges before the brown shade; subbasal line usually distinctly double.....4
4. Smaller; subterminal spots strong, the one in M_3 intensely black and rather larger than the others; ground more shaded with brown and blackish; adt. line irregular; outer line of antemedial twice looped far out below cell, almost reaching below reniform. *myconos*
   Larger; subterminal spots smaller, the upper ones dashes, cell M_3 with a large *pale* patch, sometimes bearing a *small* black dash; ground less shaded with brown; antemedial line not looped as far out in fold as in cell.....5
5. Fore wing faintly tinted with brassy; under side of hind wing with blackish outer area extensive, normally covering upper angle of cell, and sometimes almost the whole wing; postmedial line slightly straighter as a rule below cell.....*demissa*
   Fore wing gray-white in ground, or faintly bluish, not at all brassy; under side of hind wing with a moderate postmedial blackish shade, not nearly reaching cell; postmedial line typically distinctly sinuous.....*distinguenda*

Rifargia distinguenda Walker (Fig. 55)

Acronycta distinguenda Wlk. List Lep. Ins. Br. Mus. ix, 63, 1856.
Figured: Seitz 153: e2; Forbes, Sci. Surv. P.R. xii, 1: 4 ♂, 5 ♀.

The male usually has the antemedial space filled with blackish and contrasting, the female usually not; the amount and position of dark shades vary considerably, and the pm. space may be filled with blackish.

Common (see diagram, p. 245); all the specimens but one are females, and the complete absence of specimens in January (except a single one on Jan. 31), after a heavy flight in December suggests two broods. Mexico to Brazil.

Rifargia demissa Schaus

R. demissa Schs. Proc. U. S. Nat. Mus. xxix, 270, 1906.
R. d. var. *brioca* Schs. Proc. U. S. Nat. Mus. lxiii (19) 45, 1928.

In the variety the st. space is filled with a contrasting blackish fascia.

Oct. 31-May 26. No specimens were taken in January, but too few in all to make the fact very significant. Mexico to Guiana and Amazons.

Rifargia myconos Schaus

Symmerista myconos Schs. Proc. Zoöl. Soc. 1892, 336.
Figured: Seitz 153: d1 ♂.

The male usually has a large blackish apical patch, the female is without, but I have a female from the upper Amazons with a fairly intense patch. All the present lot are females.

Feb.-Mar. (Bts., A.M.N.H.). Lancetilla, Honduras, Apr. 26 (Bts.). Ranges to Brazil and Guiana.

Rifargia felderi Schaus

R. felderi Schs. Trans. Ent. Soc. Lond. 1901, 318.
Figured: Seitz 153: d4.

This belongs with *R. haitia* and *nebulosa* to a little group in which Sc and R are closely parallel for a short distance before diverging; but they have the arched costa with a long fringe of hair, unlike Meragisa.

Jan. 18 (Bts.). Mexico to southern Brazil.

Rifargia bianca Schaus

Blera bianca Schs. Proc. Zoöl. Soc. 1892, 333.
Figured: Seitz 153: e3.

R. liucata Dr. is closely related, but lacks the contrasts, having a rather even pattern of whitish and gray, like *distinguenda*, but the

oblique subbasal and pm. lines of the present. It should be taken on the Island.

Feb. 22, Mar. 3 (Bts., Fried.). Lancetilla, Honduras (Bts.). Ranges to southern Brazil.

Rifargia apella Schaus

Blera apella Schs. Proc. Zoöl. Soc. 1892, 333.
Figured: Seitz 153: e4.

Gray portions strongly glossy; besides the costal triangle, there is a small whitish antemedial spot in fold.

Common (see diagram, p. 245). In this species the January gap is broken by two specimens taken Jan. 29 and 31. Ranges south to Brazil.

Meragisa Schaus

Like Rifargia, except that Sc and R of the hind wing are always closely parallel for some distance beyond their point of connection, the costa is less arched, and not fringed with strikingly long hair.

Meragisa valdeviesoi Dognin

Orthosoma valdeviesoi Dgn. Le Naturaliste, 1890, 193.
Figured: Dognin, Lep. Loja, 5: 8; Seitz 152: h1 (det.?).

Fore wing with normal pattern clear, rather fine and black, the lines double, and median area unusually wide and buff (perhaps green when fresh). There is some resemblance to Drugera, but the basal line is waved and the pm. less extended at the middle. The Seitz figure does not show the buff median area and is perhaps a misdetermination.

Mar. 12, — also Chiriqui (A.M.N.H.). Described from Ecuador.

Magava Walker

Like Rifargia, except that the basal half of the male antenna has very long hair-tufts, appearing half pectinate to the naked eye, and the palpi are short, in the female barely exceeding the front.

Magava multilinea Walker (Fig. 56)

M. multilinea Wlk. List Lep. Ins. Br. Mus. xxxii, 503, 1865.
Figured: Biol. 90: 16; Seitz 151: g2.

Warm brown, reticulate with cream, and some small gray shades; apex pale; the double discal spots and st. spots darker brown.

Flight scattering (see diagram, p. 245). Costa Rica to Guiana and Porto Velho, Brazil. It was taken mixed with a similarly marked Cossid and a Eucleid (not yet determined).

Phastia Walker

Similar to Rifargia; wings very broad and squarish in the present species; Sc and R of hind wing closely parallel on outer half of cell, the base with a very large humeral cell reaching to middle of discal; antenna simple, but thickened at base (♂); palpi upturned to vertex, the second segment hairy above.

Phastia alcimede Druce (Fig. 57)

Oedemasia alcimede Dr. Proc. Zoöl. Soc. 1890, 510.
Figured: Biol. 90: 2; Seitz 152: k2.

Umber brown, a pale st. patch at costa; base paler, with erect outer boundary (the subbasal line) Ordinary lines double, inconspicuous, the pm. oblique on upper half, deeply concave below. Hind wing blackish.

Oct. 28-Mar. 23. Lancetilla, Honduras, Apr.-May. Ranges to Bolivia.

Drugera Schaus

Very close to Phastia. R_2 stalked from acc. cell; male antenna with a basal notch in shaft, followed by a fringe of stiff curved hair-scales in front; male legs enormously tufted. Hind wing with Sc and R forming a moderate basal cell, then closely parallel well toward apex of cell.

Drugera morona Druce (Fig. 58)

Edema morona Dr. Biol. Centr. Am. Lep. Het. ii, 455, 90: 14, 1898.
Also *figured*: Seitz 148: g6.

Pale gray, powdery, the ordinary markings slightly raised; ordinary lines double, and blurred. Basal line erect, the outer edge of a pale basal patch in male; am. outwardly oblique; pm. broadly double and blurred, offset out in cell M_3; median strong, single. Female with base less contrasting, pm. line and am. toward costa more often emphasized by a dark gray shade.

Common, flight scattering (see diagram, p. 245). Lancetilla, Honduras (Bts.) Costa Rica and Chiriqui (types).

Rincodes Schaus

A very striking type. The following species is not quite normal, exaggerated in some ways and perhaps primitive in others, but nearer this than anything else. The nearest genus appears to be the South American Gisara, which has longer third segment of palpus, more normal body tuftings and pattern. Notoplusia is close, but has pectinate antennæ.

Antenna with a short plume above; palpus massive, beak-like, but with short third joint. Thorax with high crests on tegulæ; abdomen in the present species with a high tuft on third as well as first segment (unique in the Notodontidæ, I believe) and small tufts on second and fourth. Anal tuft forming a large trough, with high crest-like sides and a flat horizontal tuft below. M_3 and Cu_1 stalked in fore wing, apparently stalked in hind wing; otherwise normal (as in Meragisa).

Rincodes flavodiscata Dognin (Fig. 59)

♀ *Chadisra flavodiscata* Dgn. Het. Nouv. Am. Sud. ii, 32, 1911.
♂ *Notoplusia distinguenda* Roth., Nov. Zoöl. xxiv, 240, 3: 2 ♂, 1917.
Also *figured:* Seitz 152: e6 ♀.

Gray with contrasting oblong bright yellow-green reniform. Female figured as with pale yellow reniform (perhaps faded). This species might be considered a Notoplusia, if the antennæ are not considered significant. It has nothing to do with Chadisra.

Nov. 25, Jan. 26, Feb. 3 (Bts.), Feb. 8 (Fried.). Lancetilla, Honduras (Bts.). Guiana (types).

Blera Walker (*Chadisra* auct. in part)

This genus and the following are distinguished by the continuous wide separation of Sc and R in the hind wing, and particularly long oblique "cross-vein" (i.e. free part of R_1). Fore wing as in Meragisa, also head and body.

Schaus and others, by considering a certain limited list of characters, have combined this genus with the Old World *Chadisra.* While the venation is almost identical, and the other superficial characters are common to most of the Notodontinæ, the larva of Chadisra as figured

by Moore (Lep. Ceylon ii, 121: 2a) is Notodontine, while the male last sternite of Blera is Heterocampine. Also the short acc. cell of Chadisra and long one of Blera are typical of the two tribes. So far as we know now, then, there is no genus common to the tropics of both hemispheres.

1. Whitish or light gray, with brown antemedial and subterminal costal patches. . . . . *arecosa*
   Dark dull brown, with dead-wood pattern. . . . . *cuculloides*

Blera cuculloides Schaus

Chadisra cuculloides Schs. Proc. U. S. Nat. Mus. xxix, 266, 1906.
Boriza lignosa Dgn. Ann. Soc. Ent. Belge, 1909, 83.
Tagela pigritia Dgn. Het. Nouv. Am. Sud. viii, 90, 1914.

Dec. 6, 1 ♀ (Bts.). Ranges to Guiana and southern Brazil.

B. arecosa Dr. covers the Canal Zone in its range, and was taken at Lancetilla, Honduras (Bts.) and Chiriqui (A.M.N.H.).

Rhuda Walker

Structures almost as in Blera, with the same wide space between Sc and R of hind wing; fore wing long and triangular, hind wing very small. Vertex with a massive tuft, antenna with a strong fringe on scape, not quite a plume.

A slight variant of Blera, more distinct in appearance than in essentials.

Rhuda focula Cramer (Fig. 60)

Bombyx focula Cr. Pap. Exot. iv, 187, 383: G, H, 1782.
Also *figured:* Seitz 151: g4.

Large; fore wing pale gray with large brown costal patch, hind wing blackish with yellow disc.

Feb. 3 (Bts.); Lancetilla, Honduras (Bts.). Guiana.

Tribe HEMICERATINI

This tribe is directly derived from the Notodontini, as the cleft or emarginate 8th sternite shows. So fas as I know it is wholly Neotropical. The first genus is more primitive in having M_1 and M_3 as widely spaced as though M_2 were still present, but has an exaggerated 8th sternite. The rest are closely related, and perhaps not all distinct.

Anita Schaus

Acc. cell long and slender, M_1 near its middle, R_2 and R_5 free, the venation otherwise normal. Fore wing in the two present species oblong with highly arched costa, more triangular in *A. divisa*. Male antenna pectinate for a variable distance, with simple tip, female pectinate in *A. cymantis*, simple in *A. basipuncta*, the genotype.

1. Fore wing with costal half faintly brassy, dorsal half fuscous, costal edge with blackish; base dark; pm. line finely lunulate, white filled..... *basipuncta*
   Fore wing dull brown, the ordinary lines blurred, double, blackish; orb. and ren. small, black, of raised scales, and a small am. raised tuft in fold; orb. an oblique bar, ren. a bar with a dot at its lower end..... *cymantis*

Anita basipuncta Schaus

A. basipuncta Schs. Trans. Ent. Soc. Lond. 1901, 332, 12: 8 ♂.
Also *figured:* Seitz 155: b2 ♀.

Dec. 11 (Bts.), Feb. 5 and Apr. 4 (Fried.), all females. Guatemala to southern Brazil.

Anita cymantis Schaus

♂ *Pronerice* (?) *cymantis* Schs. Proc. U. S. Nat. Mus. xxix, 231, 1906.
♀ *A. lassa* Schs. Proc. U. S. Nat. Mus. xxix, 279, 1906.
♂ *Proanita squalida* Dgn. Het. Nouv. ii, 43, 1911.

This synonymy is based on notes on the types in the U.S. National Museum. *P. essequeba* is near but distinct; it is light gray, much lighter than the Seitz figure (155: b4).

Nov. 29, Dec. 6, Jan. 10, Feb. 2, all females. Described from the Guianas.

Colax Hübner

Similar to Hemiceras, very large. Fore wing truncate. No acc. cell, M_1 strongly stalked, R_2 further, and R_5 beyond R_2; M_2 from middle of end of cell; hind wing relatively small, abdomen long, but without strong tuft.

Colax apulus Cramer

Sphinx apulus Cr. Pap. Exot. i, 139, 88: E, 1779.
Also *figured:* Seitz 155: d1, 2 (as *apulana*) 3? (more probably male of *C. phocus*).

Warm brown, the pm. line waved and offset on Cu, its upper half roughly perpendicular to costa. Larva (U. S. Nat. Mus.) with many or most setæ enlarged into paddle-shaped hair-scales, including vi, and about 10 setæ representing vii; body presumably green (tawny in the inflation), with a yellow stigmatal stripe, fading out at ends, the dorsum reddened above it. Head spotted, anal and a preanal plate blackish, but cervical shield pale. (Anal prolegs damaged).

C. phocus from southern Brazil is darker with the pm. line nearly even below the cell; in *Procolax apulana*, which is regional, R_2 is stalked beyond R_5 and the pm. is evenly wavy across the wing.

May 9 and June 21 (Fried.). Ranges to the Upper Amazon.

Hemiceras Guenée (with *Epicoria* Walker, etc.)

Antenna pectinate about half way to apex in male, or less, with very long simple apex, in female similar or simple, differing in closely related species. Front nearly smooth, palpi exceeding it but little, with third segment short. Fore wing with excurved outer margin, costa often noticeably straight, inner margin either simple or more or less lobed. Acc. cell slender, R_2 and R_5 free from its tip, M_1 as a rule beyond its middle, M_2 well toward upper angle of cell; hind wing with Sc and R closely parallel for a distance, then diverging well before end of cell; M_1 and M_3 noticeably approximate to margin, less than half as far apart as width of cell.

Larva smooth, with at most enlarged tubercles on 8; hind legs well developed, sometimes held raised; normally green, with subdorsal pale lines, and sometimes oblique lateral lines. Occasionally injurious to coffee shade trees (Erythrina and Inga). The larva figured by Stoll as *H. meona* (Pap. Exot. Suppl. 23: 7) does not belong here, but is probably a Malocampa, as figured by Sepp (i, 13); but *Bombyx tetrastigma* Sepp (ii, 72) is certainly a Hemiceras, and most probably *H. subdigna* or *unimacula* Dyar, which I have from Guiana; it is omitted from the Lep. Cat.

The following key is primarily for males; females usually show the same characters, but are larger, and lack the gland on the hind wing. The key leans heavily on that of Dyar (Proc. Ent. Soc. Wash. ix, 56), as modified by Draudt (Seitz vi, 1026).

1. Postmedial and antemedial lines of fore wing acutely bent a little below costa, the former then straight and a little waved to inner margin..... *commentica*

Postmedial line not sharply bent in to costa, straight, excurved, or sinuous; the antemedial either even or moderately waved.....2

2. Postmedial line even, rarely accented by dots on veins, antemedial and sometimes subbasal similar.....3

Postmedial line waved or represented by a series of dots on the veins; antemedial similar, when distinct usually forming about 4 zigzags; subbasal obscure.....11

3. Ground of fore wing in broad transverse shades; — a dark basal shade, dark before antemedial and after postmedial, and at margin on upper half; pale on basal half of median area and subterminally.....*plusiata*

Ground not so subdivided, usually unicolorous.....4

4. Subbasal line fine, even, pale, similar to antemedial.....5

Subbasal line irregular and obscure or absent.....6

5. Ground pale gray, somewhat blotchy.....*indistans*

Ground dark brown, even.....*plana*

6. Ground bright lemon yellow, more or less shaded with pale brown, but leaving terminal space clear.....*flava*

Ground not yellow, usually buff or light brown.....7

7. Postmedial line strongly oblique and nearly straight, ending on costa about $^1/_{12}$ way back from apex; dark veins, lines and a dark subterminal shade present.....8

Postmedial line reaching costa at about 5/6, nearly straight, or somewhat and evenly excurved; veins not or faintly accented, no dark st. shade.....9

Postmedial line reaching outer margin about at $^3/_4$, distinctly curved above, and normally meeting the margin almost at right angles, commonly sinuate below; a medium small species, with dull brown ground, commonly mottled, and the ante- and postmedial lines very close together at inner margin.....*deutata*

8. Warm brown (sayal brown, 15″ i of Ridgway); discal mark a short bar on lower half of discocellular and a separate spot (sometimes obsolete) on R a little before it; hind wing light brown..*colombia*

Brownish gray (drab, 17‴ of Ridgway) the hind wing correspondingly grayish; discal bar oblique, the whole height of the cell; vein-lines tend to be somewhat fusiform and to fade out before the pm. line.....*vccina*

Luteous, the brown vein-lines and shaded ordinary lines contrasting, the former running solidly up to the heavy pm. shade; hind wing luteous with buffy inner margin and no gland in male.

cadmia

9. Discal spot of two obliquely placed small, sharply defined brown spots; ground reddish brown, the hind wing hardly paler; antemedial line notably excurved.....10
   Discal spots diffuse and not contrasting; fore wing darker and duller brown, much darker than hind wing; antemedial line erect, straight.....*corema*
10. Ground light red-brown, the postmedial line yellow-brown, followed by luteous; base of hind wing luteous between veins. *clarki*
    Ground deeper red-brown, with violet tint; pm. line chestnut and tawny; hind wing (♀) pale brown to base.....*linea*
11. Ground deep bright yellow, shaded with tawny brown, and with a little white scaling at apex.....*flavescens*
    Fore wing pale and brassy yellow, or not yellow.....12
12. Basal area noticeably warmer red- or yellow-brown, contrasting with the duller or darker median area.....13
    Basal area not light and contrasting with median area, if somewhat lighter, with the color dull luteous, or the outer boundary oblique.....14
13. Basal third of fore wing buff; head with a narrow white band only, the markings not defined with white.....*meona*
    Basal third deep red-brown, only a little warmer than median area; vertex with a large white patch, white spots on scutellum and markings more or less defined with white, in particular frequently with white at the apex of the fore wing.....*nigrescens*
14. Fore wing with considerable white or whitish spots or dusting, contrasting with the brown ground, the white tending to gather antemedially in the fold.....15
    Fore wing not contrastingly marked with white or pale gray...16
15. Ground reddish buff, the whitish areas very extensive, the dorsal antemedial area and lobe largely white.....*sparsipennis*
    Ground red-brown, median area almost wholly of the brown ground color.....*coatina*
16. Fore wing strongly glossy or silky, the costal portion at least toward the base above the cell, more or less distinctly pale, usually contrasting.....17
    Fore wing not or hardly glossy, the costal portion not paler....19
17. Base of collar white or pale yellow, concolorous with the vertex, but contrasting with the gray thorax.....18
    Whole collar concolorous with rest of thorax (except for narrow

dark edgings), costal area light brassy buff and noticeably paler than dorsum in male, but nearly concolorous in female, *walkeri*

18. Ground deep silky brown, the costal area luteous and strongly contrasting. . . . . *vinicosta*

Wings dominantly pale brassy, with only the thorax and dorsal third more or less infuscated. . . . . *pallidula*

19. Costal edge of fore wing pure white, contrasting with the rest of the wing; vertex with a large white spot; inner margin of fore wing deeply lobed. . . . . *conspirata*

Costal edge of fore wing concolorous, or a little paler. 20

20. Inner margin with a strong lobe, and excavated almost in a semicircle beyond (a little less deep in H. soso, which is fuscous). . 21

Inner margin nearly even, only a little more excurved antemedially and somewhat concave beyond; ground of fore wing lighter. 24

21. Ground red-brown, vertex with well marked white scaling, which is usually also distinct on scutellum; hind wing white. 22

Ground fuscous or gray, vertex concolorous. 23

22. A medium small species, outer margin evenly rounded. . *rufescens*

A large species; outer margin sharply bent opposite cell, then oblique and nearly straight to anal angle. . . . . *micans*

23. With rather distinct dirty luteous shading in basal third, beyond the postmedial and more or less on margin; ground more brownish, sexes similar. . . . . *soso*

Ground of male lighter and decidedly grayish, the dark shading leaving a tendency to an oblique band; female all very dark with no tendency to a luteous base. . . . . *deornata*

24. A contrasting narrow blackish shade along costa; the rest of the wing (very faintly) greenish or brassy, with an oblique brassy shade from middle of subterminal region to anal angle. *monegonda*

Costal area concolorous, no distinct brassy shading. 25

25. Fore wing with ground of two shades, the darker forming a vague shade or patch from middle of cell to before anal angle and a shade from end of cell to above anal angle, leaving a paler band between them; pm. line formed of dots. 26

Ground even or irregularly mottled, without a pale oblique shade from cell to anal angle. 27

26. Female antenna simple; ground darker, more shining and more brownish, the oblique shade somewhat conspicuous. . . . . *lepida*

Female antenna pectinate at base; dark elements of pattern much

reduced and not at all contrasting; more mottled and grayer looking ..... *zula*

27. Larger, duller, t.p. dots frequently marked with white. *subochraceum*

Smaller, brighter, t.p. dots black only ..... *quebra*

Group I. Three rather even pale lines

Hemiceras indistans Guenée

H. indistans Gn. Sp. Gen. Ins. Lep. Het. vi (Noct. ii) 383, 1852.
H. echo Dyar, Proc. Ent. Soc. Wash. ix, 50, 1908.
Figured: Seitz 155: e3 (*indistans*), 4 (*echo*).

H. proximata Dgn. is probably the south Brazilian race; *H. beata* Schs. is a much darker species with dark brown hind wing, it overlaps the present one in Guiana.

Abundant from end of Jan. to end of Mar. (see diagram, p. 245). Guatemala to southern Brazil (Nova Friburgo).

Hemiceras plana Butler

H. plana Btl. Trans. Ent. Soc. Lond. 1879, 34.
Figured: Seitz 155: f1.

Abundant (see diagram). Guiana and Amazons, apparently not reaching southern Brazil.

Group II. Ordinary lines acutely angled below costa

Hemiceras commentica Schaus

H. commentica Schs. Proc. U. S. Nat. Mus. xxix, 285, 1906.
Figured: Seitz 156: e4, 5.

The area between the antemedial line and the large gray reniform is usually but not always strongly ruddy; the pm. line varies in the amount of dentation and of accompanying white. Guiana specimens are noticeably darker and browner, in some with a strong fuscous gray terminal area.

Common (see diagram). Guiana and the Amazon.

Group III. Ante- and postmedial lines even and pale, not angulate, but basal obscure

Hemiceras plusiata Felder

H. plusiata Fld. Reise Novara Lep. 97: 11, 1874.
Also *figured:* Seitz 155: e2.

H. jejuna Schs., from southern Brazil, is much lighter, gray instead of brown.

Common (see diagram, p. 245). Ranges to Bolivia and Southern Brazil.

Hemiceras colombia Dyar

H. colombia, Dyar, Proc. Ent. Soc. Wash. ix, 52, 1908.
Figured: Seitz 155: h3.

H. bilinea is closely similar, but has much less brown along the pm. line, and paler hind wing. *H. tricolora* has a fore wing like the present species, but mostly white hind wing.

Common (see diagram). Described from Colombia.

Hemiceras vecina Schaus

H. vecina Schs. Trans. Ent. Soc. Lond. 1901, 335.
Figured: Seitz 155: h2.

Smaller and much grayer than the last, the st. shade less regular and veins much darkened.

Common (see diagram). Mexico to Colombia and Venezuela, reappearing in southern Brazil (Minas and Espirito Santo).

Hemiceras cadmia Guenée

H. cadmia Gn. Sp. Gen. Lep. Het. vi (Noct. ii) 383, 13: 2, 1852; Smith Bull. xliv, U. S. Nat. Mus. 260, 1893; Dyar Bull. lii, U. S. Nat. Mus. 257, 1903; Hambleton and Forbes, Arch. Inst. Biol. (S. Paulo) vi, Suppl. ii, 243, 1935.
Comidava obliquilinea Wlk. List Lep. Ins. Br. Mus. xxvi, 1695, 1862.
Cargida cadmia Holl. Moth Book fig. 381, 1903 (from type of *obliquilinea* — also figures venation and legs).
Also *figured:* Seitz 155: i1 (too dark for normal coloring).

Small, ground straw, brown shading on pm. line heavy; st. shade variable, often crossed by conspicuous fine brown bars on veins. The absence of a stigma distinguishes this species from all of this group.

Feb. 1 (Bts.), Feb.-Mar. (A.M.N.H.), July 22 (Banks). Texas to southern Brazil. Originally described from "North America," presumably Georgia or Florida.

Hemiceras flava Schaus

H. flava Schs. Proc. U. S. Nat. Mus. xxix, 286, 1906.
Figured: Seitz 155: i3.

Large, antemedial line erect, as in the preceding species, but weak.

Nov.-Mar. (see diagram, p. 245) (Bts., Fried., A.M.N.H.). Costa Rica (type) and Muzo, Colombia.

Hemiceras clarki Schaus

H. clarki Schs. Ann. Mag. Nat. Hist. (8) vii, 285, 1911.
Figured: Seitz 156: a4.

Light brick red. In Seitz' figure the two discal spots are represented as separate and equal, the key places them as united; our specimens have the upper much smaller than the lower or weak.

Nov. 11-Mar. 3 (Bts., A.M.N.H.). Mexico to Venezuela.

Hemiceras linea Guenée

H. linea Gn. Sp. Gen. Lep. Het. vi (Noct. ii) 381, 1852.
Not *figured.*

A single female agrees with a single male in the U. S. National Museum determined as this species. It is identical in markings with *clarki*, but much darker and redder, and may be merely a color form, in which case the name *linea* of course has priority.

June 27 (Fried.). Brazil (type and specimen in Nat. Mus.); Bolivia (Ddt. in Seitz).

Hemiceras dentata Dognin

H. dentata Dgn. Hét. Nouv. Am. Sud. vii, 30, 1914.
Figured: Seitz 156: b2.

Most of the specimens are much more mottled than Seitz' figure, especially subterminally. The pm. line is noticeably excurved, and usually retracted to the inner margin.

Abundant (see diagram). Colombia, Peru.

Larva from Changuinola Distr., Bocas, Panama (Swift); light green; pupa naked. A pest on coffee shade trees.

Group IV: Postmedial line dentate, generally oblique from costa, but with the tooth below Cu_1 *accented; base of fore wing paler, buffy; inner margin with moderate lobe and notch.*

Hemiceras meona Cramer

Bombyx meona Cr. Pap. Exot. iv, 132, 358: B, 1797.
Hemiceras meona Guenée, Sp. Gen. Lep. Het. vi (Noct. ii) 385, 1852, (except larva).
Eulophopteryx splendens Msch. Verh. z.-b. Ges. Wien xxvii, 684, 1878.
Also *figured:* Seitz 156: d5.
Not *B.* or *H. meona* Stoll, Suppl. Cr. Pap. Exot. 25: 7; Guenée, l.c.—larva.

The antemedial line is oblique out in general course, the scallop below A the farthest out; the lunules of the pm. line in M_1 and M_2, M_3 and Cu_1 tend to form pairs and Cu_2 and two in the fold a triplet, — corresponding to the paired dots of *H. punctata.*

Not rare (see diagram, p. 245), the chief flight in Feb. Guiana.

Hemiceras soso Dyar

H. soso Dyar, Proc. Ent. Soc. Wash. ix, 54, 1908.
Figured: Seitz 156: k4.

Much smaller and duller than *H. meona,* with very little of its gloss, the t.p. line almost regular and sometimes difficult to trace.

May 19 (Fried.). Lancetilla, Honduras. Mexico to Venezuela.

Group V. Postmedial line waved or punctate, usually quite regularly from costa to inner margin; base of fore wing not pale (redder only in H. nigrescens*); lobe of inner margin and the following notch very strong.*

Hemiceras nigrescens Schaus

H. nigrescens Schs. Trans. Ent. Soc. Lond. 1901, 340, 12: 9, 1901.
H. obliquiplaga Dyar, Proc. U. S. Nat. Mus. liv, 359, 1919.
Also *figured:* Seitz 156: i1.

A deeper colored version of *H. meona* with the notch stronger, coloring warmer, pm. more regular and am. line erect from lower edge of cell to inner margin.

Flight scattering (see diagram) in 1934–35, not taken in 1936. Ranges north to Mexico.

Hemiceras flavescens Schaus

H. flavescens Schs. Proc. U. S. Nat. Mus. xxix, 287, 1906.
Figured: Seitz 156: f3.

Bright yellow, more orange than *H. flava*, with Indian red shading, white dusting, dots on lines, and marks on head and scutellum, as in various species of this group. Hind wing straw yellow. Pm. tooth below Cu_1 emphasized as in *soso*.

Oct. 25 (Bts.), Jan. 7 (Fried.), Feb. 8, 9, Mar. 12 (A.M.N.H.).

Hemiceras walkeri Schaus

Salamboria deornata Walker List Lep. Ins. Br. Mus. xxxiii 855, 1865.
Hemiceras walkeri Schs. (n.n.) Trans. Ent. Soc. Lond. 1901, 334.
Figured: Seitz 156: e2.[1]

Male generally paler than female, the paling toward the costa more distinct. Both have the st. dots enlarged into small spots at costa and inner margin, the latter enclosed in a fine black lunule belonging to the pm. line. *H. metallescens* Schs. is similar, but the pale costa and dark dorsum are separated by a sharp boundary on Cu_2.

Oct.; Feb. to June (all collectors). Chiriqui, Mexico.

Hemiceras pallidula Guenée (Fig. 61)

H. pallidula Gn. Sp. Gen. Lep. Het. vi (Noct. ii) 381, 13: 1, 1852.
Larva: Schaus, Trans. Ent. Soc. Lond. 1901, 340.
Also *figured:* Seitz 156: e5.

Similar to the preceding, smaller, paler, the inner margin more contrastingly gray; st. of a regular series of gray shades on veins. The genotype of Hemiceras.

Larva maroon, with two broad subdorsal yellow bands, ending at tubercles on 8th segment of abdomen, 3 lateral white lines; head and prothorax yellow, with black bands; tail white above; true legs and anal prolegs black, the other prolegs red.

The species varies a good deal in size, and most of the specimens

[1] The two *deornatas* of Walker, *Epicoria d.* (p. 853) and *Salamboria d.* (p. 855) stand in confusion. I am following the specimens as labelled by Schaus in the National Museum, but cannot reconcile the result with Walker's descriptions. Seitz has them mixed, citing *walkeri* to the reference for the wrong *deornata*, omitting both *deornatas* in the bibliography, and substituting *deornata* wrongly for *walkeri* in the text of this species.

seen, except from the Canal Zone, have two or more white spots on fore wing. The variation is not local.

Jan. 25 (Bts.), Feb. 14, 18, Mar. 11 (A.M.N.H.). Mexico to southern Brazil.

Hemiceras sparsipennis Walker

H. sparsipennis Wlk. List Lep. Ins. Br. Mus. xii, 972, 1857.
Epicoria canosparsa Wlk. List Lep. Ins. Br. Mus. xxxiii, 853, 1865.
Figured: Seitz 156: f5.

Easily recognized by the light color and very extensive white markings.

Common (see diagram, p. 245) Guatemala to Brazil.

Hemiceras coatina Schaus

H. coatina Schs. Proc. U. S. Nat. Mus. lvii, 144, 1921.
Figured: Seitz 156: g1.

Mar. 25, May 2 (Fried.). Guatemala and Costa Rica.

Hemiceras losa Druce

H. losa Dr. Proc. Zoöl. Soc. Lond. 1890, 511.
H. carmelita Mssn. in Stubel's Reise 148, 7: 4, 1890.
H. lepida Schs. Ann. Mag. Nat. Hist. (8) vii, 284, 1911.
Also *figured:* Seitz 156: e4.

The synonymy is after Draudt; our specimens are compared with the type of *lepida* Schs. The species is very near the following, and the male almost indistinguishable, but is browner, smoother looking, the fore wing perhaps more pointed.

Dec. 10, 23, Jan. 28 (Bts.). Costa Rica to British Guiana and Upper Amazons. The National Museum has a grayer specimen from Peru, which may be the true *carmelita*.

Hemiceras zula Schaus

H. zula Schs. Ann. Mag. Nat. Hist. (8) vii, 286, 1911.
Figured: Seitz 156: e3.

Not rare, chief flight at end of Dec. (see diagram). Costa Rica.

Hemiceras deornata Walker

Epicoria deornata Wlk. List Lep. Ins. Br. Mus. xxxiii, 853, 1865.
Hemiceras cotto Dyar, Proc. Ent. Soc. Wash. ix, 55, 1908.
Figured: Seitz 156: h3 ♀.

Grayer, more mottled, not glossy, the pale oblique shade strongly curved; discal bar and pm. line more contrasted in male; female dark with all markings less contrasting.

This is the identification of the National Museum, Walker's description suggests a redder species, and does not mention the dark discal bar or prominent oblique shade of the male.

Dec. 10, 25 (Bts.), ♀'s. Lancetilla, Honduras ♂ (Bts.). Mexico to southern Brazil.

Hemiceras conspirata Schaus

H. conspirata Schs. Proc. U. S. Nat. Mus. xxix, 289, 1906.
Figured: Seitz 156: g4.

Large, bright red brown, with the line fine and only the pure white costal edge, and markings on head, scutellum and notch of fore wing, distinct.

Chief flight in Feb. (see diagram, p. 245). Mexico to southern Brazil.

Hemiceras micans Schaus

H. micans Schs. Proc. U. S. Nat. Mus. xxix, 289, 1906.
Figured: Seitz 156: i5.

Very close to the last; costal edge buff, hind wing nearly white. Perhaps a mere color form.

Feb. 27, 1 ♂ (Fried.). Mexico.

Group VI: Postmedial line waved or punctate, usually straight in general course; inner margin only rounded out antemedially and straight or slightly concave beyond.

Hemiceras vinicosta Guenée

H. vinicosta Gn. Sp. Gen. Lep. Het. vi (Noct. ii) 384, 1852.
Figured: Seitz 157: d4 ♂, 5 ♀.

Very distinct by its dark silky color with contrasting pale costal shade. Inner margin not concave at all.

Common (see diagram, p. 245). Ranges to French Guiana, the Amazons and Porto Velho, Brazil (Nat. Mus.).

Hemiceras monegonda Schaus

H. monegonda Schs. Proc. U. S. Nat. Mus. lxxiii (19) 63, 1928.
Not *figured.*

Large, wings ample; light red-brown; head with a white bar between antennæ; costa blackish, inner fringe dark brown, the inner margin not at all concave. No contrast, only the vague reniform and a curved shade from beyond it to above anal angle a little more distinct; lines slight, punctate. Hind wing white with some reddish shade.

Dec. 22, 30, Jan. 22, Feb. 7 (M. C. Z.) Mar. 18 (A.M.N.H.). Costa Rica (type). Male unknown.

Hemiceras subochraceum Walker

H. subochraceum Wlk. Char. Undescr. Lep. Het. 184, 1866.
H. mora Dr. Biol. Centr. Am. Lep. Het. i, 251, 1887.
Figured: Seitz 157: a1.

Ground lighter and markings darker shades of brown, without any contrasts; ren. a little darker; lines faint and accompanied by black and white points. Expanse of average male 40 mm., female somewhat larger. Base color Ridgway's Tawny Olive (17″ i), overlaid with snuff brown (15″ k) or bistre (15″ m).

Larva injurious to coffee shade trees (Swift),— a dark larva spinning a cocoon.

Common (see diagram). Ranges to Mexico.

Hemiceras quebra Schaus

H. quebra Schs. Tr. Ent. Soc. Lond. 1901, 339.
Not *figured.*

Extremely similar, somewhat smaller (35 mm.). Wing possibly a little shorter; color a little redder, the overlay nearest to Verona Brown (13″ k).

A female is doubtfully placed here, Feb. 3 (Fried.); also a male from Lancetilla, Honduras. It was described from Venezuela, and is exceedingly close to *H. rava* Schs. from Costa Rica and *H. kartabena* Schs. from Guiana. Only genitalic study will show if all these names represent distinct species or not.

Hapigia Guenée

Very large. Palpi upturned, with second joint thick and smooth, third short; front smooth; scape smooth-scaled, without the rough hair of almost all the family, base of stalk thickened in male, with basal joints fused and forming a triangular prominence, this prominence and the scape crossed by an oblique groove. Antenna ciliate. Wings pointed, fore wing without acc. cell, R_2 stalked beyond R_5, M_1 free or barely stalked, M_2 from middle of end of cell, middle discocellular long and oblique; hind wing small, with Sc and R touching at a point at or beyond middle of cell; male frequently with a prominence near base and sex scaling.

A derivative of Hemiceras.

1. With several shaded bands perpendicular to the costa, three alternate ones stronger (the third representing the postmedial). *nodicornis*
   Postmedial line normal in course; at most with traces of the shaded bands 2
2. Reniform, costo-apical and some other spots green 3
   These spots silver, pale golden or nearly concolorous 4
3. Ground lighter, green color almost confined to cell-spots, the subapical spot mainly blackish . . . . . *smerinthina*
   Ground darker and more mottled, with considerable green antemedially and subapically . . . . . *repandens*
4. Postmedial line slightly excurved, metallic apical spot minute . . 5
   Postmedial line strongly excurved; apical metallic spot a conspicuous crescent, filled with a whitish spot; ground warmer brown, hind wing relatively paler . . . . . *curvilinea*
5. Postmedial line not sinuous, erect or slightly and evenly excurved, not retracted in fold . . . . . *simplex*
   Postmedial line somewhat sinuous and strongly retracted (either roundly or in a cusp) in fold 6
6. Spots at end of cell pale golden, conspicuous . . . . . *raatzi*
   Spots at end of cell blackish, with a faint brassy underlay, which gives them an olive tint in brilliant lighting . . . . . *eneana*

Hapigia nodicornis Guenée

H. nodicornis Gn. Sp. Gen. Lep. Het. vi (Noct ii) 376, 12: 7, 1852.
Also *figured:* Seitz 157: e1, 2 (as *annulata*).

In the true *annulata* the abdomen is annulate, blackish and buff, in

obliqua there are four finer and equidistant bands on fore wing, in *hollandia* the margin is deeply scalloped. Male with a knob on Sc of hind wing where it is closest to R.

Jan. 9-Mar. 28; Lancetilla, Honduras (Bts.). Guatemala to Guiana (type) and Brazil (Cornell).

Hapigia curvilinea Schaus

H. curvilinea Schs. Trans. Am. Ent. Soc. xxx, 149, 1904.
Figured: Seitz 158: a1.

Ground rich brown, usually with a contrasting buff spot near base of fold; pm. blurred, strongly excurved.

Dec. 1-Mar. 22 (see diagram, p. 245). Guatemala to southern Brazil.

Hapigia smerinthina Schaus

H. smerinthina Schs. Proc. U. S. Nat. Mus. lxxiii (19) 67, 1928.
Figured: Seitz 157: f3 (as *smerinthoides*).

Ground dull straw; reniform rather small, much smaller than in the true smerinthoides, which has a brighter buff and more mottled ground.

Jan. 29, Feb. 23 (Bts.). Ranges to Surinam and southern Brazil.

Hapigia repandens Schaus (Fig. 63)

H. repandens Schs. Proc. U. S. Nat. Mus. xxix, 291, 1906.
Figured: Seitz 157: 2 ♂ (as *abscondens*), 1 ♀.

H. notha is more mottled, normally with buff patches; *H. gaudens* is darker, with contrasting white costal spots; *H. abscondens*, from Bogota, is described as blackish brown with a silver discal spot, and is obviously not the species from Brazil figured by Seitz. Druce (Biol. 92: 7) figures a true Crinodes under this name.

Chief flight at beginning of March (see diagram). Reported from Mexico to Brazil, at hand from Guiana and Santa Catharina, Brazil.

Hapigia simplex Walker

Corymbia simplex Wlk. List Lep. Ins. Br. Mus. xxxiii, 766, 1865.
Lobogona hapygia Fld. Reise Novara Lep. 98: 4, 1874.
Hapigia ribbei Dr. Biol. Centr. Am. Lep. Het. i, 244, 25, 8, 1887.
Also *figured:* Seitz 158: a2 (*simplex*), 4 (*ribbei*).

Draudt treats *ribbei* as a distinct species, with silver dots on the antemedial line, but I consider it a mere color form; Druce's figure of the type (♀) does not have them.

Two of our specimens have three buff spots before the am. line as in the Seitz figure, the other two are without, as in Druce's figure. The postmedial line may be evenly excurved (as in all the figures and most specimens), bent opposite cell, or practically straight.

Not rare in 1934-5 (see diagram), not taken in 1936. Lancetilla, Honduras (Bts.) also before me from Guiana and Iquitos, Peru.

Hapigia raatzi Möschler

Chliara raatzi Msch. Verh. z.-b. Ges. Wien xxxii, 350, 1883.
Figured: Seitz 158: a3.

The pm. typically forms a cusp in the fold, but may be evenly incurved. The present group and all specimens at hand except one from Venezuela are lighter than the type.

Jan. 4, Feb. 2, Apr. 22, Nov. 27. Guiana and Amazons.

Hapigia eneana Schaus

H. eneana Schs. Proc. U. S. Nat. Mus. lxxiii (19) 68, 1928.

Like *H. raatzi* except for the dark ordinary spots, and perhaps a mere color form.

Oct. 9 (Bts.), Feb. 26 (Wood — A.M.N.H.). Lancetilla, Honduras (Bts.). Guatemala (type).

Rhapigia Schaus

Like Hapigia, except for a strongly lobed anal angle of fore wing.

1. Larger, outer margin even; pm. line mostly straight, simple, ordinary spots dull; base of inner margin buff, contrasting. *accipiter*

   Smaller, outer margin somewhat waved; pm. line excurved and accompanied by double black dots, the pair in fold typically enlarged, ocellate; base of inner margin concolorous. . . . *aymara*

Rhapigia accipiter Schaus

Hapigia accipiter Schs. Proc. Zoöl. Soc. 1892, 340.
Figured: Seitz 158: e2.

Oct. 31-Mar. 3 (Bts., Fried.). Described from Brazil.

Rhapigia aymara Schaus

Hapigia aymara Schs. Proc. U. S. Nat. Mus. xxix, 292, 1906.
Figured: Seitz 158: e3.

Feb. 15, 1 ♂ (Friedman). Described from French Guiana.

Chliara Walker

Like Hapigia, but with scape and basal part of shaft merely thickened, not notched. (See Fig. 62).

Chliara cresus Cramer

Bombyx cresus Cr. Pap. Exot. ii, 72, 142, C, 1780.
C. moneta Fld. Reise Novara Lep. 96: 7, 1874.
Also *figured:* Seitz 158: b2.

Straw with brown reticulation and markings, and much pale gold. I can see no difference between typical *cresus* (British Guiana, *not* Brazil), *moneta* (Amazons, not Panama) and the present Panama lot. *C. c. imperialis* Walker is distinct, with less silver and with the more reddish hind wing mentioned by Walker, but is hardly a distinct species.

Jan. 26 (Bts.), Feb. 12, Mar. 9, 11 (A.M.N.H.), June 17 (Fried.). Ranges to Guiana and the Amazons (type of *moneta*, also C.U.) and in a race to southern Brazil (type of *imperialis* and C.U.).

Antæa Hübner

Like Hapigia except male antenna not notched, with dense hair-scales above; palpus with third segment long; fore wing with a large lobe rather before middle of inner margin, the anal lobe slight and well beyond the pm. line. Usual lines slightly raised.

Antæa juturna Cramer

Phalæna Noctua juturna Cr. Pap. Exot. ii, 48, 129: E, 1780.
Also *figured:* Seitz 158: c1.

Light red brown, lines fine; orb. and ren. large, oblong and inverted U-shaped, the latter interrupting the median line. St. line offset at Cu_1 and Cu_2 but not M_3 (unlike the other species).

End of Jan. to Mar., late June (see diagram, p. 245). Ranges south to Brazil.

Subfamily CERURINÆ

The typical Cerura group are nearly world-wide, though perhaps best developed in Asia, and represented only by a single subgroup of Cerura with a few species in the Neotropical. Kaseria is put here with much doubt; it has the Cerurine head, but has lost M_2 of the hind wing, has preserved all hind tibial spurs, and the larva is inknown. Bates took a female at Lancetilla, Honduras.

Cerura Schranck

Antennæ pectinate to apex in both sexes; M_2 of hind wing strong; base of M traceable and forked in both wings, both forks ending below M_2; acc. cell of fore wing minute or absent; hind tibia with end spurs only (except a few extra-limital species).

The genus has been subdivided into Cerura proper, Harpyia and Andria, but the differences are slight, larval and imaginal characters do not correspond, and there is no corresponding difference in pattern type. The present species would belong to typical Cerura, but is aberrant in pattern.

Brower has investigated this group and found that there are differences in genitalia not reflected in pattern differences, so the present determination is tentative, pending critical study.

Cerura rarata Walker (Fig. 64)

C. rarata Wlk. List Lep. Ins. Br. Mus. xxxii, 409, 1865; Druce, Biol. Centr. Am. Lep. Het. 91: 7; Barnes and McD. Contr. Nat. Hist. Lep. ii (1) 2: 2, 1913 (from Brownsville, Texas), Check List No. 3668, 1917, no. 3932, 1938.
Also *figured:* Seitz 148: b4 ♂, 3 ♀.

Pure shining white, with black wave-lines. Larva presumably on willow, like *annulifera* Berg (Burmeister Lep. Argent. 503).

Chief flight in June (or later) (see diagram, p. 245). Southwest U.S. to Tucuman, Argentina; not seen from the Amazon basin.

DIOPTIDÆ

Ocelli weak and covered by vestiture or absent; tongue strong, palpi upturned to middle of vertex or beyond, usually closely scaled; thorax and abdomen slender, usually close-scaled; the legs close-scaled, except a few Andean species, even the femora being smooth. Fore wing without accessory cell, R_3 and R_4 generally stalked the farthest; M_2 from

middle of end of cell, M_1 mostly free, M_3 and Cu_1 usually stalked in both wings and R and M_1 in hind wing; cell sometimes shortened, M_1 and M_2 then thickened with a more or less distinct stridulating organ in male; hind wing with Sc and R closely parallel along basal part of cell, but free; tympanum of Notodontid type, most often small and inconspicuous.

Larva (*Phryganidia*) essentially as in the Notodontidæ, not modified, the last legs but little reduced; the skin minutely rugose. Pupa with hooked dorsal setæ on abdomen and long tongue.

The family is Neotropical. Besides the species described, all of which have striking colors or patterns, Banks caught a single female apparently transitional to the Notodontidæ, slender, but soft winged and inconspicuously marked with gray dusting on a white ground. It shows the characters, so far as I can make out, of Momonipta.

1. R_2 of fore wing from cell, M_3 and Cu_1 remote..... *Phœochlæna*
   R_2 and M_3 of both wings stalked.....2
2. Hind wing with a vein lost, R and M_1 united; male with reduced hind wing and costal sex-scaling..... *Getta*
   Hind wing with complete venation, R and M_1 stalked.....3
3. Face and palpi with rough projecting hair, the roughness of the face most striking on sides beside the closely held palpi.....4
   Face and palpi close-scaled.....5
4. White species; scape with loose hair-scales; palpi barely upturned to middle of front..... *Momonipta* ?
   Black species; scape rather closely and densely scaled; palpi upturned to vertex..... *Actea*
5. Upper discocellular vein of fore wing oblique and about as long as middle one; cell short, M_1 and M_2 tending to be swollen at bases.....6
   Upper discocellular much shorter than middle one; cell long..*Josia*
6. Scaling thin; veins dark..... *Tithraustes*
   Scaling dense; white vein-lines..... *Scotura*

Phlæochlæna Hübner

Dyar reports *P. gyon* F. (*tendinosa* Hbn.) from the Zone. It is brown with yellow veins and pale, partly yellow spots.

Momonipta Warren (*Stenoplastis* Felder ?)

Banks caught a female, apparently of this genus but too poor to describe.

Scotura Walker

Most of the species are gray with contrasting pale veins and more or less white on disc of hind wing.

Scotura fulviceps leucophleps Warren

[*Cymopsis fulviceps* Fld. Reise Novara Lep. 105: 25, 1868.]
[*Figured:* Seitz 68: (*fulviceps*), 12 (*f. peruviana*).]
[*S. nervosa* Schs. Jour. N. Y. Ent. Soc. iv, 154, 1896; Prout, Nov. Zoöl. xxv, 408, 1918; Forbes Jour. N. Y. Ent. Soc. xxxix, 69, 1931 (race of *fulviceps*).]
S. leucophleps Warr. Nov. Zoöl. xvi, 74, 1909.
S. nervosa leucophleps Seitz 68: 14; etc.

The Canal Zone material may be treated as a race, though the differences from e.g. the Amazonian specimens are small. The present lot are all of a plain striped pattern, but other races are dimorphic, some specimens having white spots on the fore wing.

Common (see diagram, p. 245). Range (in races) to Costa Rica, Guiana and the Amazons.

Dyar reports *Tithraustes hæmon* Dr. (Seitz 69: a5) from the Zone. It is translucent gray, with a large white discal spot on each wing, and two small subterminals on fore wing.

Actea Butler

A variant of Josia, differing only in the rougher face and perhaps longer palpi. Earlier workers than Prout frequently extend the genus to include the similarly marked species which Prout transfers to Josia.

Actea pseudena Boisduval

Retila pseudena Bdv. Consid. Lep. Guat. 94, 1870.
Figured: Seitz 70: f2.

Black with a yellow transverse stripe on fore wing. Abdomen with yellow lateral stripes and dorsal dots.

Jan. 3 (Bts.), July (Banks), Feb.-Mar. (A.M.N.H.). Mexico to Colombia.

Josia Hübner (with *Ephialtias*, etc.)

All the species are black, with relatively simple patterns in yellow, less often red and white. There are many named forms, only a fraction

of which are probably good species, the body characters being in general more specific than those of the wings. My key (Jour. N. Y. Ent. Soc., xxxix, 74) is complete as to species, I believe, but does not pretend to place all the named forms.

1. Abdomen with a middorsal longitudinal stripe as well as lateral ones; hind wing red ..... *draconis*
   Abdomen middorsally black; hind wing not red 2
2. Hind wing wholly black; fore wing with an oblique or transverse yellow stripe ..... *ena*
   Hind wing with a broad yellow or orange stripe 3
3. Abdomen with a transverse basal yellow band ..... *cruciata*
   Abdomen with side stripes only ..... *ligula*

Josia draconis Druce

Actea (?) *draconis* Dr. Biol. Centr. Am. Lep. Het. i, 145, 14: 6, 1885.
Also *figured:* Seitz 70: h2.

A large transverse yellow band on fore wing, and a longitudinal red one on hind wing. Probably only a minor local race of *J. bryce,* and reported from the Zone by Dyar under that name.

Dec. 20 (Bts.), Feb. 29, Mar. 11, 19 (A.M.N.H.), July-Aug. 3 (Fairchild). Ranges in races to Guiana and the Amazons.

Josia ena Boisduval

Retila ena Bdv. Consid. Lep. Guat. 95, 1870.
Ephialtias tryma Schs. Jour. N. Y. Ent. Soc. iv, 154, 1896.
Figured: Seitz 71: g1.

Only a single yellow band on fore wing, much broader than in *Actea pseudena.*

Mar. 17 (Lutz — A.M.N.H.), July-Aug. (Fairchild). Ranges to Guiana and Peru.

Josia cruciata Butler

J. cruciata Btl. Ann. Mag. Nat. Hist. (4) xv, 340, 1875; Forbes Jour. N. Y. Ent. Soc. xxxix, 74 (in key).
Figured: Seitz 71: d2 (as *annulata*).
Not J. annulata Dgn., which has a very narrow stripe on the fore wing.

Both wings have a broad central yellow stripe.

Mar. 11 (Lutz — A.M.N.H.). General distribution uncertain

through confusion with related species. Described from Chiriqui; ranges at least to Guatemala (Biol.) and Peru (Cornell).

Dyar reports *J. fulvia* (i.e. *ligula*) from the Zone; it is very similar, but without the transverse stripe on the abdomen.

Getta Walker

Differs essentially from Josia only in having R and M_1 completely united instead of stalked, and shows the same pattern. The males usually have the hind wing modified.

Getta beatifica Druce

Ephialtias bætifica (sic) Dr. Ann. Mag. Nat. Hist. (7) i, 213, 1898.
Figured: Seitz 71: k5.

Black, the basal half of fore wing, hind wing and abdomen suffused with blue; fore wing with a yellow transverse fascia. Male with lobed costa and sex-patches.

Mar. 11 (Gertsch — A.M.N.H.) July-Aug. (Fairchild). Colombia to Peru.

EXPLANATION OF PLATES

PLATE 1

PLATE 1

Male genitalia of Macrocneme species (p. 124)

Each figure is in four parts: a, right side of entire genitalia; b, left valve; c, dorsal view of tegumen and uncus; d, scoop (presumed juxta). In several cases where the bases are not shown the figures are from specimens pulled out but not detached.

1. *M. cinyras*
2. *M. chrysitis*
3. *M. thyra*
4. *M. thyridia*
5. *M. thyridia*, a second specimen showing extreme of variation, especially in the uncus. In the right side figure the uncus is retracted, but actually essentially as in fig. 4.
6. *M. leucostigma*
7. *M. aurata*

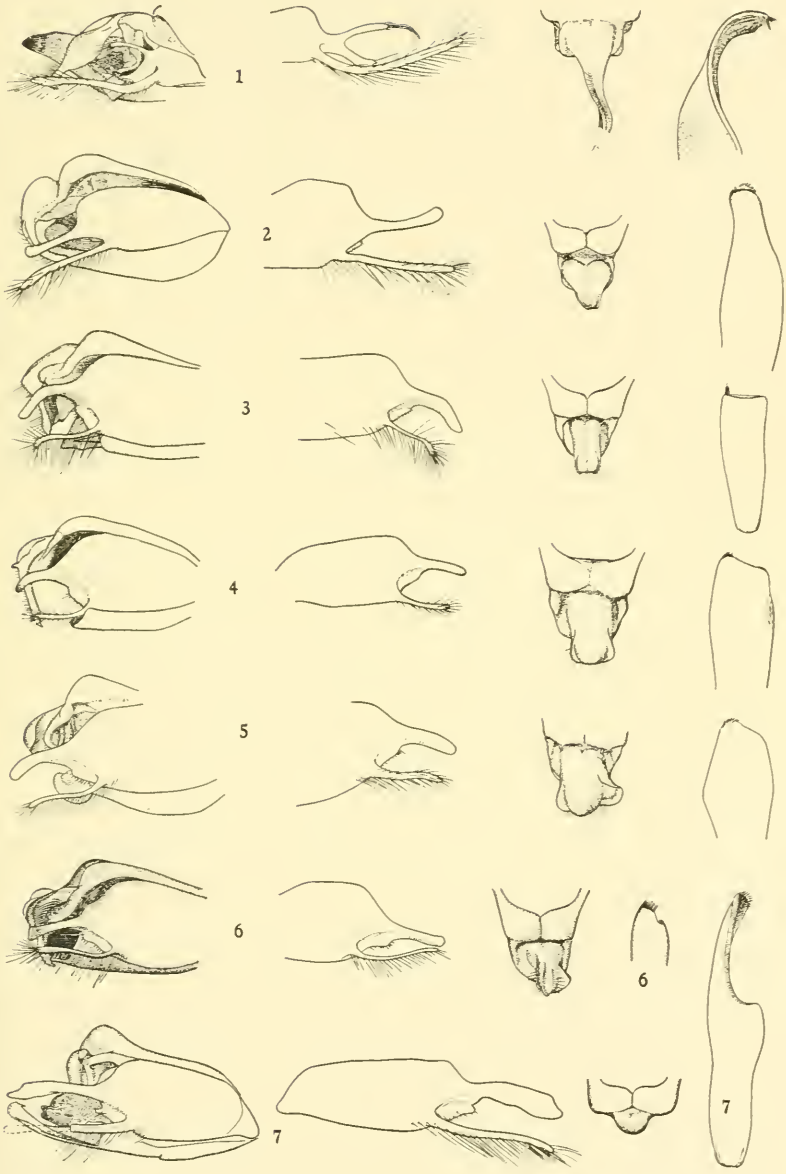

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PLATE 2

PLATE 2

Male genitalia of Macrocneme species (p. 124)

Each figure is in four parts: a, right side of entire genitalia; b, left valve; c, dorsal view of tegumen and uncus; d, scoop (presumed juxta). In several cases where the bases are not shown the figures are from specimens pulled out but not detached.

8. *Macrocneme* species
9. *M. auripes*
10. *M. eacus*
11. *M. nigritarsia*
12. *M. cyllarus* (in the specimen figured, a Central American one without exact data, I can find no trace of the lateral process of the tegumen; in others it is small and far down on the side.)
13. *M. sura*
14. *M. albitarsia*

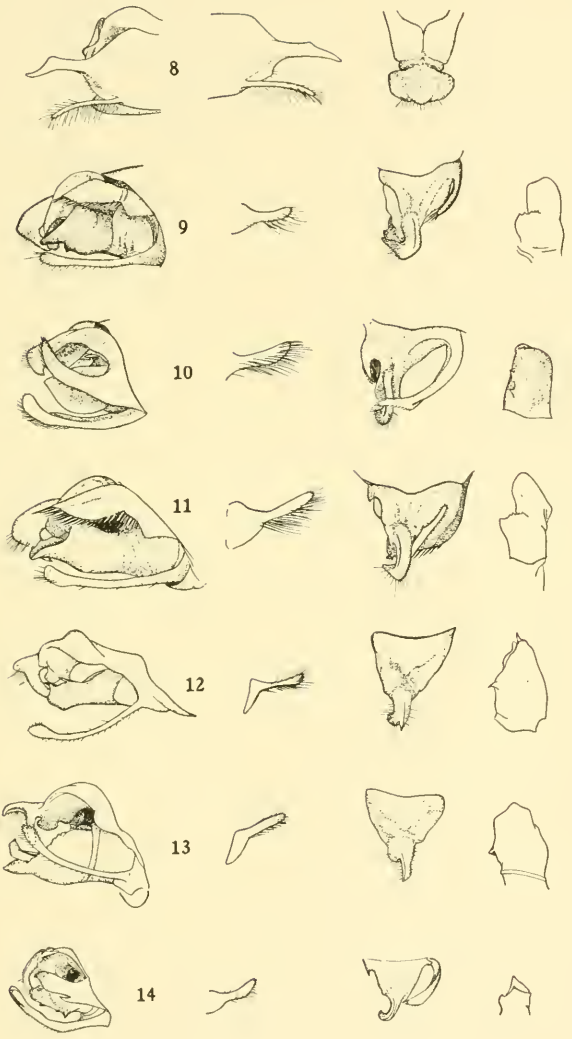
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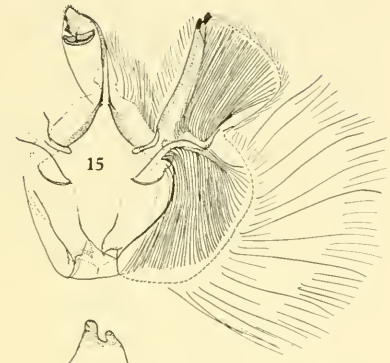
PLATE 3

PLATE 3

Male genitalia of Tachuda (p. 259)

Each figure is in three parts: the genitalia proper, opened out from the ventral surface, with the left valve omitted; the last sternite, and the ædœagus.

Fig. 15. T. discreta (French Guiana).
Fig. 16. T. punctum Forbes (Lancetilla, Honduras).
Fig. 17. T. pachydexius Forbes (Barro Colorado Id.).
Fig. 18. T. albosigma (Barro Colorado Id.).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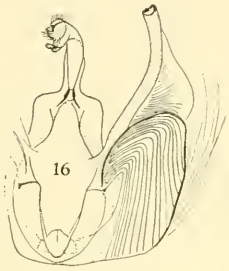
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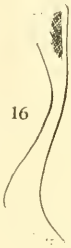
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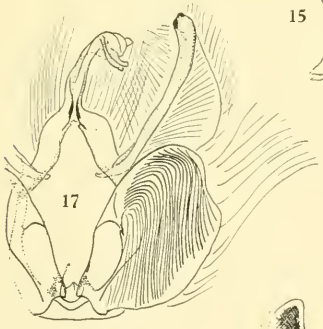
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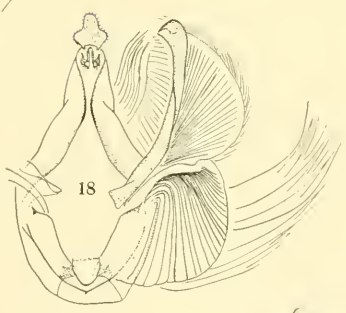
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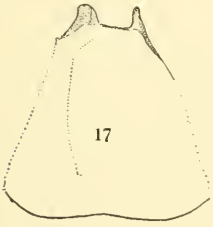
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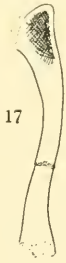
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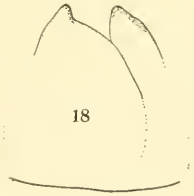
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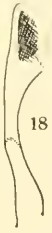
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PLATE 4

PLATE 4

Male genitalia of Apela (pp. 271–280)

Each figure is in three parts: the genitalia proper, opened out from the ventral surface, with the left valve omitted; the last sternite, and the ædœagus.

Fig. 19. A. neobule (Lancetilla, Honduras).
Fig. 20. A. acutidivisa (Surinam).
Fig. 21. A. lilacina (Surinam).
Fig. 22. A. divisula Forbes (British Guiana).
Fig. 23. A. asema Forbes (Manãos, Amazons) type.
Fig. 24. A. cataphæa Forbes (Tumatumari, British Guiana).

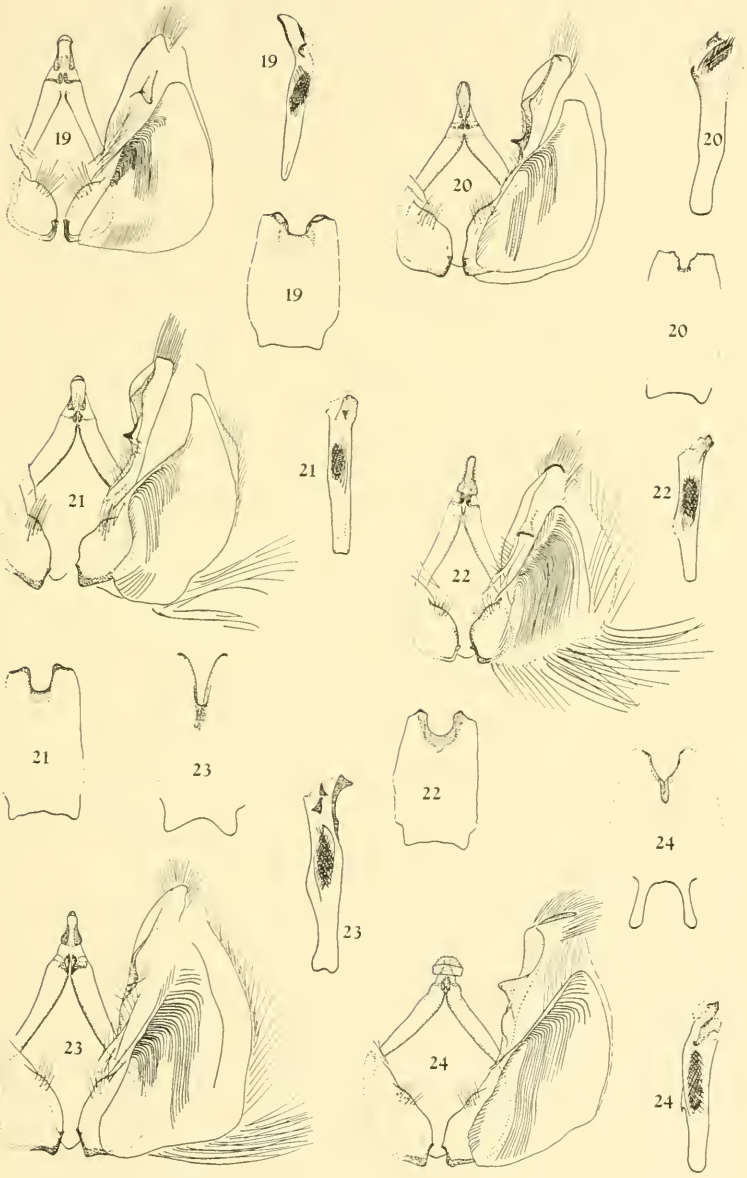
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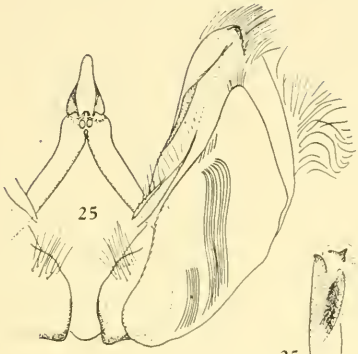
PLATE 5

PLATE 5

Male genitalia of Apela (pp. 271–280)

Each figure is in three parts: the genitalia proper, opened out from the ventral surface, with the left valve omitted; the last sternite, and the ædœagus.

Fig. 25. A. rufinsulæ Forbes (La Venta, Ancon, Panama).
Fig. 26. A. archimma (Tumatumari, British Guiana).
Fig. 27. A. strigatula Forbes (Tumatumari, British Guiana).
Fig. 28. A. punctilla Forbes (Mackenzie, British Guiana).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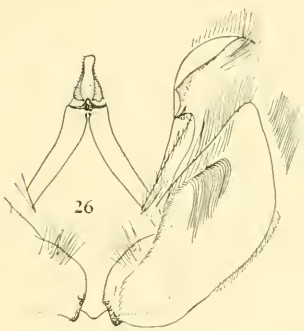
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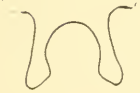

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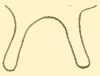

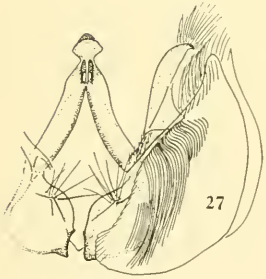
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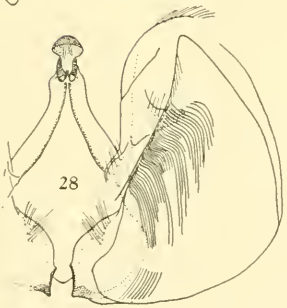
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PLATE 6

PLATE 6

Venations

Fig. 29. Crinodes biedermanni (Arizona), lettered according to the Comstock-Redtenbacher system. (page 264)
Fig. 30. Rosema zelica (Guiana). (page 247)
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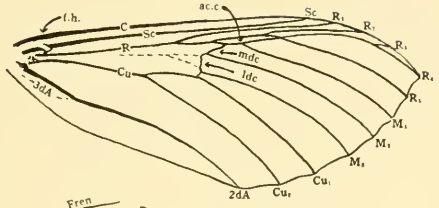

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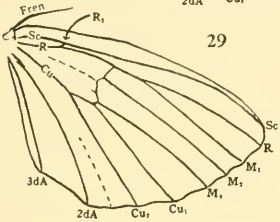

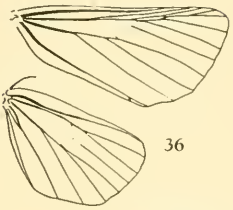

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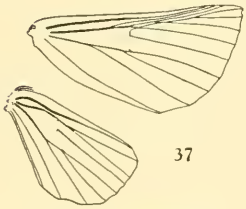

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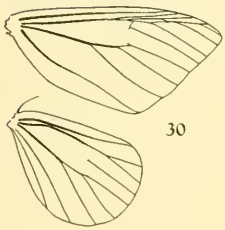

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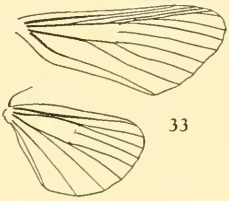

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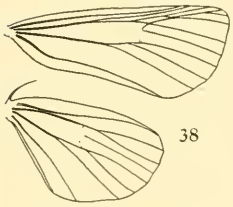

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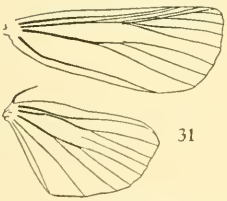

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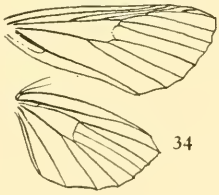

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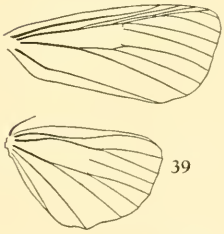

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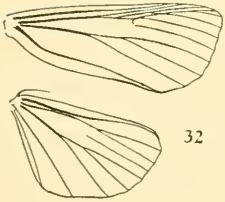

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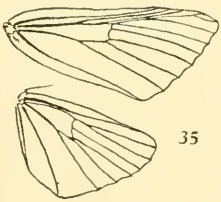

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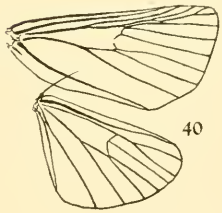

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PLATE 7

PLATE 7

Venations

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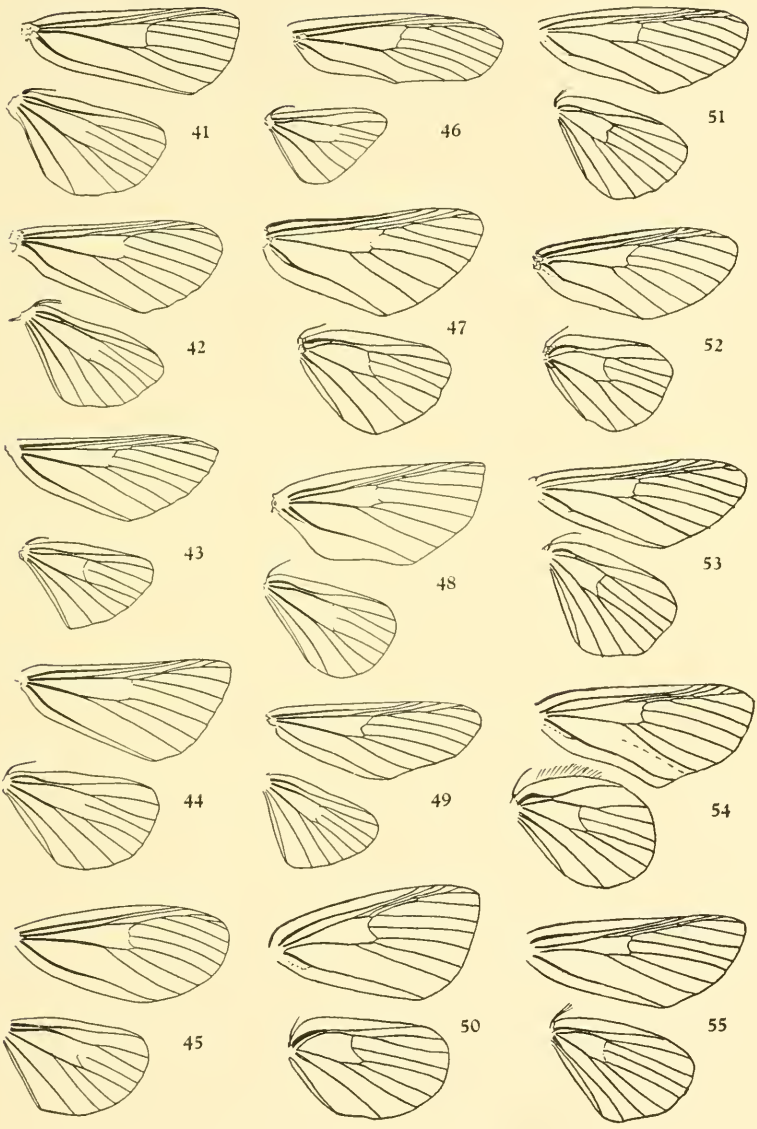
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PLATE 8

PLATE 8

Venations

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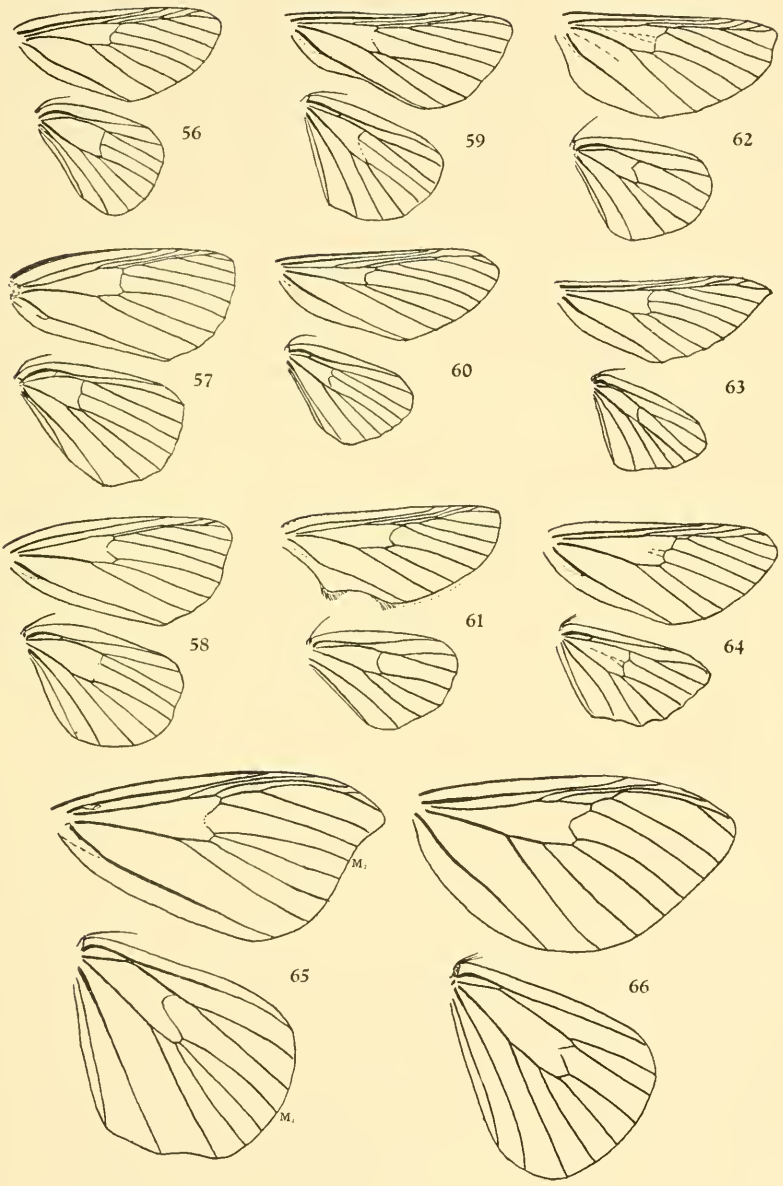
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Bulletin of the Museum of Comparative Zoology
AT HARVARD COLLEGE
Vol. LXXXV, No. 5

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OSTEOLOGY OF SEYMOURIA BAYLORENSIS BROILI

By T. E. White

With Three Plates

CAMBRIDGE, MASS., U.S.A.
PRINTED FOR THE MUSEUM
August, 1939

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No. 5. — *Osteology of Scymouria baylorensis* Broili

By T. E. White

Because of its intermediate position between the amphibia and reptilia, *Scymouria baylorensis* Broili has been given more consideration than any other Palaeozoic tetrapod. Broili (1904), Williston (1911), and Watson (1918) have given us excellent descriptions of the skeleton. Watson made very valuable comparisons with the amphibia and cotylosauria and gave us a true appreciation of the position which it occupies. Due to faulty preservation and lack of sufficient material many points have been left in doubt in the previous descriptions. It is the purpose of the present paper to give a clear and detailed account of the structure of the skeleton of this primitive tetrapod.

There are, in the collection of fossil reptiles in the Museum of Comparative Zoology, a number of specimens of this species from the Clear Fork Permian of West Coffee Creek, Baylor County, Texas. This material was collected by C. H. Sternberg in May, 1882. He thought at the time that he had collected a single specimen and labeled it "Reptile B." The work of cleaning and fitting together of the fragments soon proved that "Reptile B" contained the remains of nine individuals. Several such "pockets" containing a number of individuals of the same species have been found in the Permian of Texas. Although no specimen is complete, the several specimens supplement each other, so that it is possible to make a fairly complete study of the osteology of this species.

The material consists of two nearly complete skulls, one skull with the occipital region removed, one skull with the rostrum gone, the right half of a skull, the left half of another skull, and the fragmentary remains of two other skulls, three complete lower jaws, and seven lower jaws with the articular end missing. In addition there are isolated skull elements freed by maceration.

The material for the remainder of the skeleton consists of six humeri, five radii, two ulnae, fifteen femora, six tibiae, four fibulae, four scapulae, three coracoids, six clavicles, three interclavicles, twelve pubes, twelve ischia, three ilia, six sacral vertebrae, eight sacral ribs, about eighty vertebrae, and a few complete ribs.

The bones were imbedded in a purplish red clay which is easily removed by washing. Next to the bone is a thin layer of calcite which flakes off rather easily.

I wish to express my gratitude to Professors T. Barbour and A. S. Romer for the privilege of studying this material, and the free use of the collection for making comparisons. From the latter I have received many helpful suggestions. Through the courtesy of Dr. C. W. Gilmore of the U. S. National Museum and Dr. Everett Olson of Walker Museum, I received the loan of additional material. I am also indebted to Professor W. K. Gregory of the American Museum of Natural History for the loan of the type of *Conodectes favosus* Cope. The value of the paper has been greatly enhanced by the drawings of the braincase by Mr. L. I. Price and of the remainder of the skeleton by Miss Mary Carter.

In most cases the figures are composites rather than any single element. There has been sufficient material at my disposal so that no conjecture is necessary. Any detail which was not present on one element could be found on another.

The Skull

In general appearance, the skull very closely resembles those of the rhachitomous Amphibia. It is relatively low and a little longer than broad. It is broadest across the quadrates. The width decreases uniformly from the quadrates to the snout. The width of the latter is about half that across the quadrates. The orbit is a little behind the middle of the skull and faces laterally. It is not the typical circular orbit of the majority of the reptiles and amphibians of this time. The superior and anterior borders describe the segment of a circle. At the anterior-inferior angle there is a well-defined notch. The inferior border is straight and is 25 mm. long. The posterior-inferior border is also straight. It is about two-thirds as long as the inferior border and as long as the posterior border which is also straight. The otic notch is deeply incised. Its depth is equal to half the distance from the posterior border of the orbit to the hinder margin of the skull. It faces laterally rather than dorso-laterally as do most of the rachitomi.

The dermal bones of the skull roof bear the reticulate sculpture characteristic of the contemporaneous Amphibia. The reticulations seem to be nearly uniform in most of the specimens. However, in No. 1082, which seems to be a younger specimen than the others, the reticulations are finer near the center of the bone.

Along the superior and inferior borders of the orbit and the anterior border of the otic notch the arrangement of the sculpture strongly sug-

gests remnants of the lateral line system. If this is true *Seymouria* cannot be far removed from its amphibian ancestry.

In the two complete skulls there is a noticeable difference in the

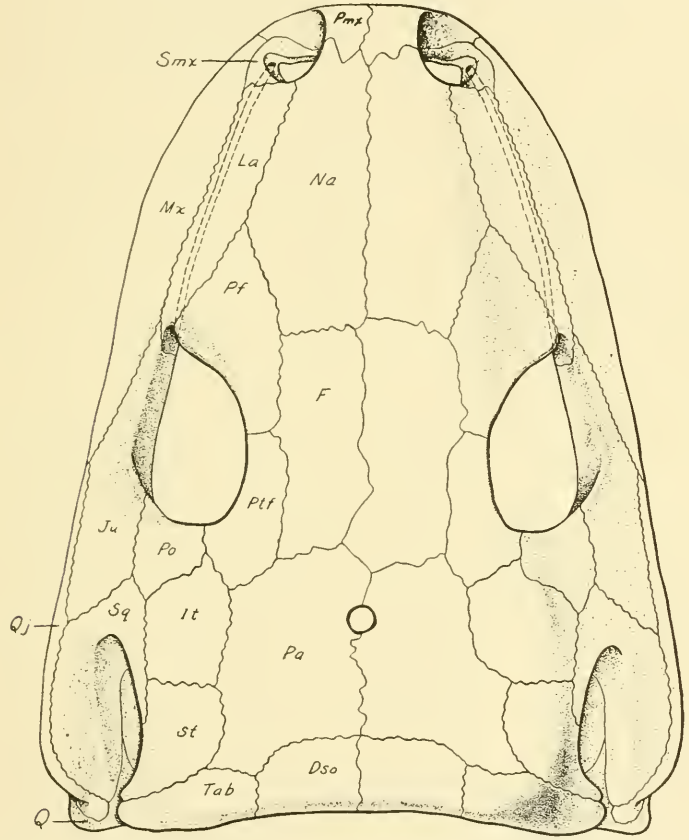

Fig. 1.[1] Dorsal view of skull. x 1. The dotted lines indicate the course of the lachrymal duct.

distance from the orbit to naris. This is undoubtedly an age or sex difference rather than a specific one. In modern Amphibia and Reptilia closely related species of the same size do not occur in the same habitat and region.

[1] See pages 408-9 for explanation of abbreviations in all figures and plates.

Measurements of Skulls
(in millimeters)

Museum Numbers	1082	1081	1086	1084	1083	1085
Length along top of skull	100	112				
Length along side of skull	108	117			112	
Breadth across quadrates	80	88	86			
Breadth across tabulars	58	66	65	64		
Interorbital breadth	32	34	37			
Orbit to naris	34	40			33	
Orbit to hinder margin of skull	43	44	47	44		
Orbit to otic notch	18	22	25	22	21	20
Pineal foramen to hinder margin of skull	22	25	29	26		

Premaxillary. The premaxillary constitutes the anterior part of the rostrum. It is sculptured in the same manner as the upper surface of the skull. The suture between the premaxillaries is not marked by any change of sculpture. The premaxillary unites with the nasal about the middle of the external naris in a crenulated suture running across the rostrum. It joins the maxillary in an overlapping suture in the inferior border of the external naris. On the palatal surface the premaxillary extends on the inner side of the maxillary as far back as the posterior border of the external naris, while on the outer surface it terminates at about the middle of the inferior border of the external naris. On the palate the premaxillary meets the prevomer in an overlapping suture and bears a short process which with its fellow projects posteriorly between the prevomers. It bears five teeth of uniform size. One tooth in specimen No. 1082, which was nearly complete, projected 3 mm. below the outer border of the premaxillaries. There is no sutural union between the premaxillary and the septomaxillary. The latter lies in contact with the premaxillary on the inferior border of the external naris.

Maxillary. The maxillary extends backward nearly to the posterior border of the orbit. It meets the jugal in an overlapping suture which extends obliquely across the infraorbital area. It meets the lachrymal in a crenulated suture in the area between the external naris and the orbit. In specimen No. 1081 the maxillary contains 16 teeth, in Nos.

1082 and 1083 it contains 17 teeth. The first tooth is the same size as those in the premaxillary. The second, third, fourth and fifth are enlarged to more than twice the size of the first. In specimen No. 1087 the third tooth, which has the tip broken off, projects 8 mm. beyond the border of the maxillary. Posterior to the fifth, the teeth diminish uniformly in size. The last tooth is slightly smaller than those in the premaxillary. The maxillary is swollen in the area of the enlarged teeth.

On the palatal surface the maxillary meets the palatines and the ectopterygoid in an interlocking suture. It forms the median third of the lateral border of the internal naris.

Septomaxillary. Specimen No. 1081 has the right septomaxillary preserved. It has been lost in all of the other specimens. It is suturally united to the lachrymal and maxillary and rests on the premaxillary. It extends across the external naris and probably came in contact with the nasal septum. The lower border of the median end rests on the prevomer. The upper border curves downward from the suture with the lachrymal for a short distance. From this point to the median end it is nearly straight. On the anterior side near the median end is a small deep groove.

It is not at all certain that a septomaxillary foramen is present. No. 1081, the only specimen in which the septomaxillary is present, is slightly crushed in this area. All of the other specimens show a small crescentic notch in the anterior border of the maxillary near the lower end of the septomaxillary suture. In the badly preserved type of *Conodectes favosus* Cope there is what appears to be a small foramen in the same position.

The arrangement of the bones around the external nares made it necessary for the air to pass over the septomaxillary. The passage of air around the median end or beneath the septomaxillary would have been impossible. Consequently the nostril would have been dorsal in position.

Watson (1918) associates Jacobson's Organ with the septomaxillary. This is open to question because, in modern reptiles, only in the highly modified skull of the snake is this true. In lizards and terrestrial tortoises it is closely associated with the median ethmoid. In the extremely short nasal passage of *Seymouria* it has left no impression on any of the bones preserved.

Lachrymal. The lachrymal extends from the anterior border of the orbit to the posterior border of the external naris. It is limited to the anterior-inferior angle of the orbit by the growth of the prefrontal.

Anteriorly the lachrymal unites with the septomaxillary, which excludes the most of the former from the external naris. The lachrymal with the nasal forms the superior border of the external naris.

The lachrymal duct enters the bone just a little above the inferior border of the orbit and passes through the bone, close to the maxillary suture, to the naris. Specimen No. 1085 is fortuitously broken so that it shows the entire course of the duct. In skull No. 1083, in which the right lachrymal has been partially freed by maceration, both the entrance and exit of the lachrymal duct are shown. The lachrymal duct leaves the orbit through a single foramen. The duct notches the lower edge of the prefrontal and enters the lachrymal about 3 mm. above the inferior border of the orbit. Probably in some cases the lachrymal duct perforates the lower edge of the prefrontal because the extent of the lachrymal in the anterior border of the orbit is not equal in any two specimens, nor is it equal on both sides of the same specimen. The duct leaves the lachrymal through a foramen, about 1 mm. in diameter, about 5 mm. above the lower border of the naris. It passes upward and inward through the upper portion of the septomaxillary to the naris.

The lachrymal extends downward on the inner side of the maxillary and is suturally united with the palatine.

Nasal. The nasal forms the posterior-medial border of the naris; anteriorly it unites with the premaxillary; posteriorly it unites with the frontal, laterally with the lachrymal anteriorly and the prefrontal posteriorly. Anteriorly the nasal is very thin and delicate; posteriorly it thickens to meet the rather strong frontals. On the ventral side of each nasal near the anterior end a low broad ridge arises which becomes larger posteriorly. At the posterior end of the nasal the ridge is about 2 mm. high and 3 mm. broad. These ridges continue backwards onto the frontals and terminate in a transverse ridge which lies just in front of the orbitosphenoids. In specimen No. 1082 the ridges are 10 mm. apart at the union of the nasals with the frontals. The valley between the ridges probably housed the rhinencephalon.

Frontal. The frontal occupies the interorbital area but is excluded from the border of the orbit by the pre- and post-frontal. Posteriorly it unites with the parietal. On the ventral side the frontal is suturally united with the orbitosphenoid. The frontal extends as far backward as the posterior border of the orbit and as far forward as the anterior border.

Prefrontal. The prefrontal forms the anterior border of the orbit and about half of the superior border. It unites medially with the

anterior portion of the frontal and the posterior portion of the nasal. Laterally it unites with the lachrymal. A broad plate-like process curves inward and forward from the anterior border of the orbit. An isolated prefrontal (No. 1090) freed by maceration shows clearly that this process is an outgrowth of the prefrontal and not a separate bone. Ventrally this process unites with the medial side of the lachrymal at its posterior end, and with the palatine just back of the palatine tusks. The lower half (Fig. 2D) is broadly emarginate in a nearly perfect

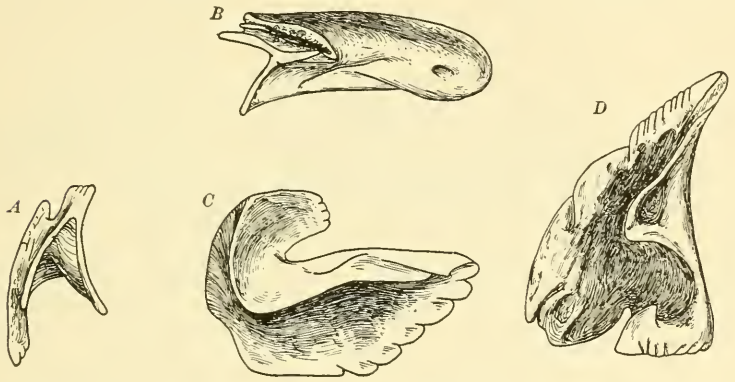

Fig. 2. A, B and C, anterior, dorsal and medial views of right squamosal. x 1. D, medial view of right prefrontal. x 3/2.

crescent. The vertical diameter of the emargination is 7 mm. in No. 1090 and 10 mm. in Nos. 1084 and 1081. Its horizontal diameter is about 5 mm. in all of the specimens. It is probable that Harder's gland (*glandula membrana nictitans*) was enclosed by this process. Harder's gland, the complement of the lachrymal gland, is well-developed in the recent Amphibia and Reptilia and the lower mammals. It seems highly probable that it was equally well-developed in *Seymouria* and other early tetrapoda. It may have been even better developed than the lachrymal.

Jugal. The jugal forms the inferior and about one-third of the posterior border of the orbit. It joins the maxillary in an oblique suture in the infraorbital region. It joins the lachrymal in a short suture at the anterior-inferior angle of the orbit. Posteriorly it joins the squamosal and postorbital. Ventrally it joins the quadratojugal which excludes it from the lower border of the skull by meeting the maxillary.

The jugal sends a wedge a short way between the quadratojugal and squamosal. The jugal does not join the palatine but sends a short process medially to meet the ectopterygoid above the maxillary.

Quadratojugal. The quadratojugal is a long narrow bone which forms the inferior border of the skull between the maxillary and the quadrate. It meets the maxillary and ectopterygoid in short interlocking sutures. Dorsally it unites with the jugal and squamosal. Posteriorly it unites with the quadrate.

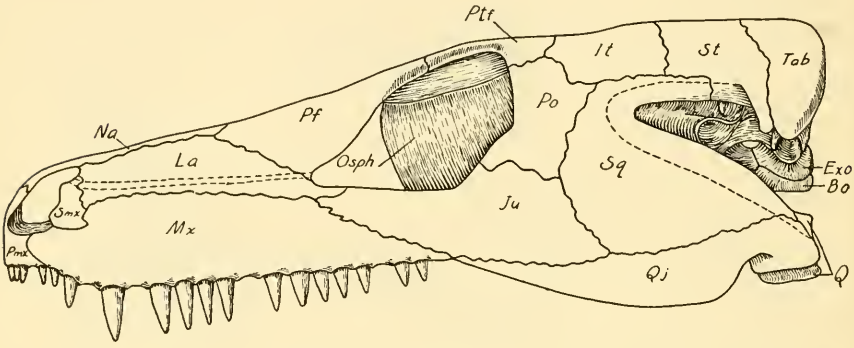

Fig. 3. Lateral view of skull. x 1. The dotted lines on the snout indicate the course of the lachrymal duct. The dotted line around the otic capsule indicates the limit of sculpture of the skull roof.

Postorbital. The postorbital forms about half of the posterior border of the orbit. It unites dorsally with the postfrontal and intertemporal, posteriorly with the squamosal, and ventrally with the jugal. On the medial side of the postorbital is a shallow, elliptical depression which probably sheltered the lachrymal gland. This pit is best shown in No. 1084, and in an isolated postorbital, No. 1090.

Intertemporal. The intertemporal is a small pentangular bone lying in the postorbital region. It is bounded anteriorly by the postfrontal and postorbital, medially by the parietal, posteriorly by the supratemporal, and laterally by the squamosal. It is excluded from the otic notch by the ascending process of the squamosal.

Parietal. The parietal lies behind the frontal in the interotic region. It is roughly quadrangular in outline. It unites anteriorly with the frontal and postfrontal, laterally with the intertemporal and supratemporal, and posteriorly with the tabular and dermosupraoccipital.

The pineal foramen is about one-third of the length of the bone from the anterior end. The shape of the foramen is that of an inverted funnel. The diameter on the ventral surface of the bone is about one and one-half times that of the dorsal surface. Behind the pineal foramen the parietal thickens toward the midline and forms a sharp narrow ridge ventrally along the median suture.

Dermosupraoccipital. The dermosupraoccipital is a short broad bone which lies behind the parietal and forms about half the posterior border of the skull. On the posterior side of the skull the suture between the dermosupraoccipital and tabulare extends obliquely down-

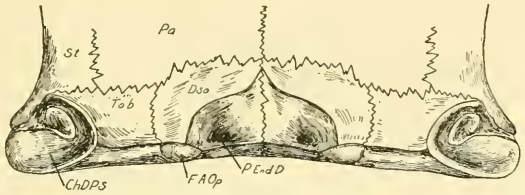

Fig. 4. Ventral view of posterior portion of skull table. x 1.

ward and inward nearly to the foramen magnum. This downward growth of the tabular has greatly reduced the posttemporal fenestra, which is rather large in the Stegocephali. In the area between the otic capsules and above the posterior portion of the brain is a triangular area (Fig. 4) which descends abruptly from the ventral surface of the dermosupraoccipitals. It is much thicker and heavier than the remainder of the bones. The apex of the triangle is directed forward and lies on the suture between the two bones just behind the parietals. The whole of the occipital flanges of the dermosupraoccipitals goes into the formation of the base of the triangle. The posterior two-thirds of the sides of the triangular area are produced into broad thin processes which project forward and downward. The posterior portion of this process articulates with the proötic behind the superior semicircular canal. In each basal angle, just median to the superior semicircular canal, is a small shallow pit which probably received the upper end of the endolymphatic duct. This thickened area may, in part, be a compensation for the cartilaginous supraoccipital.

Tabular. The tabular is a short broad bone which forms the lateral portion of the posterior border of the skull. Its transverse dimension on the skull roof is 22 mm. and its antero-posterior dimen-

sion is 8 mm. The lateral end projects downward somewhat and partially closes the otic notch. On the posterior side of the skull the tabular sends a process downward and inward which unites with the dermosupraoccipital and reduces the posttemporal fenestra. At its extremity this process unites with the ascending process of the opisthotic near the latter's union with the exoccipital (Fig. 5).

The lateral half of the tabular supports a pair of high thin ridges on its ventral side. The posterior ridge (Figs. 4 and 8) begins at the most lateral extremity of the bone and passes along the posterior border

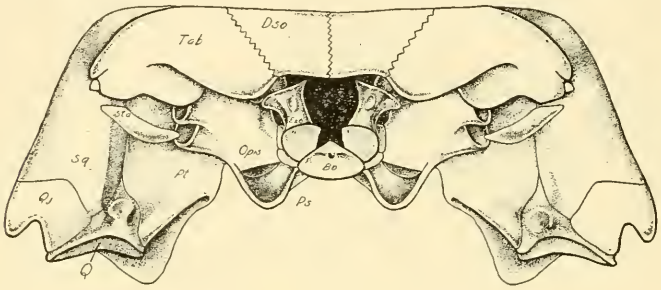

Fig. 5. Posterior view of skull. x 1.

almost to the descending process of the tabular. Here it turns forward and, curving slightly outward, continues to the anterior border of the tabular. As nearly as can be determined (the very thin edges were badly broken in cleaning), the posterior ridge projects about 3.5 mm. below the surface of the tabular. This ridge overlaps the paroccipital process of the opisthotic on the posterior side. The anterior ridge is separated from the posterior by a U-shaped valley about 4 mm. wide. The course of the anterior ridge is nearly parallel to that of the posterior, except that the inner end curves sharply outward (Fig. 4) near its termination. The U-shaped valley between the ridges coincides with a groove on the lateral end of the otic capsule, thus forming a nearly closed channel which terminates just above the inner end of the stapes. It seems probable that this channel enclosed the cartilaginous dorsal process of the stapes and the upper end of the hyoid.

Supratemporal. The supratemporal forms about half of the superior border of the otic notch, lying between the squamosal and tabular. It is bounded anteriorly by the intertemporal, medially by the parietal, posteriorly by the tabular, and laterally by the squamosal and otic

notch. The supratemporal forms the anterior half of the process at the (Fig. 3) posterior side of the otic notch. It excludes the tabular from contact with the tympanic membrane.

Squamosal. The squamosal shows considerable departure from the usual condition in the early tetrapods in that it forms a little more than half of the superior border of the otic notch. Normally in the Palaeozoic Amphibia the otic notch is not deep and the squamosal extends only to the anterior angle. *Trematops* is an exception to this rule, since the squamosal extends a short distance along the superior

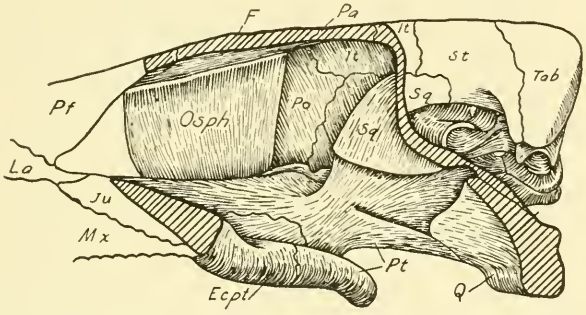

Fig. 6. View of posterior half of skull with postorbital region removed. x 1.

border from the anterior angle of the otic notch. Since the relationships of the intertemporal and supratemporal to the squamosal have not changed appreciably, it seems probable that the squamosal has been incised by the otic notch. The very deep otic notch seems to indicate that *Seymouria* possessed a very large tympanic membrane.

Ventrally the squamosal overlaps the quadratojugal broadly on the outside. Anteriorly it unites with the jugal and postorbital in an interdigitating suture. Dorsally it underlaps the intertemporal and supratemporal.

The portion of the process under the supratemporal extends forward, downward, and backward, and is united with the quadrate ramus of the pterygoid in a broad overlapping suture (Fig. 6). An isolated squamosal (Fig. 2, A, B, and C) No. 1090, shows the extent of the sutural contact. Posteriorly the squamosal overlaps the ascending ramus of the quadrate. The vertical extent of this contact is about 15 mm. This is proportionally a greater contact that is found in most

Rhachitomi and seems to forecast the condition found in other cotylosaurs and the pelycosaurs.

Quadrate. The articular surface of the quadrate is two-lobed, more like the Captorhinomorpha and Pelycosauria than the Rhachitomi. The outer lobe is broadly oval and the inner lobe long and narrow. The outer lobe lies below the quadratojugal, which is thick and heavy in this region. The quadratojugal extends inward nearly to the inner border of the squamosal (Fig. 5). The dorsal border of the pterygoid ramus of the quadrate extends upward along the medial border of the squamosal for about 15 mm. It terminates abruptly and shows evidence of a cartilaginous extension which continued along the side of the pterygoid. There is, along the outer side of the pterygoid, a broad shallow groove to receive this cartilaginous extension of the quadrate (Fig. 6). The width and depth of this groove gradually decreases anteriorly till it disappears in the region of the basipterygoid articulation.

Above the inner condyle of the quadrate is a protuberance, about 5 mm. in diameter, at the lower end of the squamosal (Fig. 5). It has an unfinished upper surface and must have had a cartilaginous termination. The upper surface of this protuberance is crescentic in outline. The two ends of the crescent are more prominent than the central portion and give the protuberance the appearance of being bilobed. Watson (1925, p. 206) described a pit in the same position in *Orthosaurus* and its allies. It is his contention that this pit received a process from the extracolumella. By inference this would be the *pars anterior.* According to Versluys (1899, 1904) the extracolumella is united with the quadrate in most of the recent reptiles sometime during their development. It is, therefore, not improbable that such a connection was normal in the adults of the early tetrapoda.

Pterygoid. The palate of *Seymouria* is completely closed (Fig. 7) except for the internal nares and the infratemporal fenestrae. As far as I know, *Seymouria* is the only Palaeozoic tetrapod which does not have the interpterygoid vacuities. However, the absence of the vacuities does not imply any great change in the general scheme of the palate. The difference between the palates of *Orthosaurus* and *Seymouria* is very small and the change from the former to the latter would be too slight to have any significance. The pterygoid is the most important bone in closing the palate. It is united with its fellow along the midline from just in front of the enlarged vomerine teeth to a short way in front of the hypophysial fontanelle. In this region it lies in a groove in the side of the parasphenoid, thus eliminating any

possibility of fenestra in this region. This is very well shown in No. 1081, which is fortuitously broken through this region and shows this very clearly.

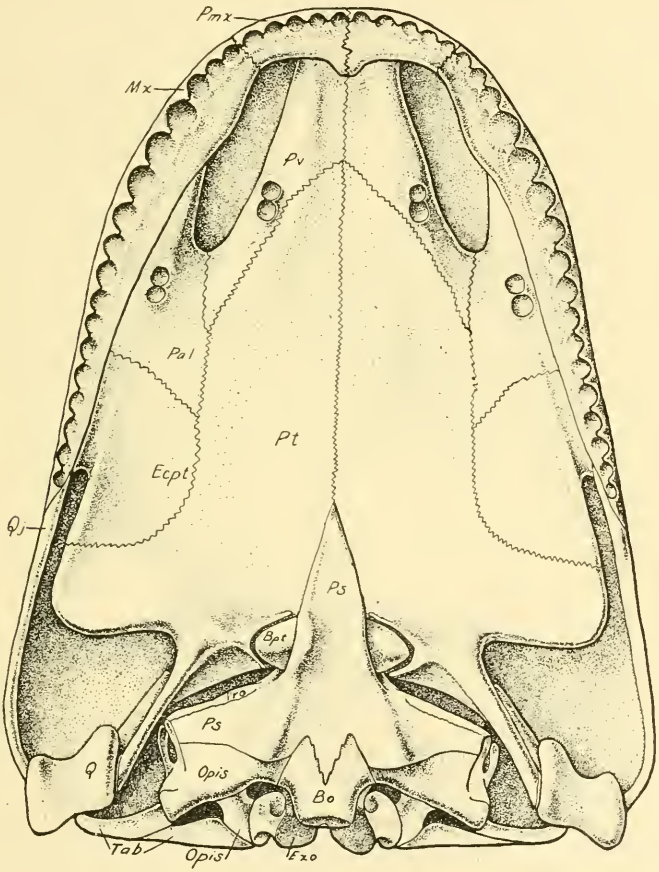

Fig. 7. Ventral view of skull. x 1.

The anterior ends of the pterygoids project forward, on the ventral surface of the palate between the posterior ends of the prevomers. This seems to be the normal condition in those reptiles and amphibians in which the pterygoids come in contact with the prevomers. On the dorsal side of the palate the vomers overlap the front ends of the

pterygoids for a distance of about 18 mm. but do not meet in the midline above them. Laterally the pterygoid unites with the palatine and ectopterygoid. The pterygoid makes up the greater part of the flange and receives the greater part of the origin of the pterygoideus muscle.

Posteriorly the pterygoid unites with the quadrate and squamosal. The articulation with the quadrate has been adequately described under that bone. The pterygoid unites with the squamosal above the quadrate, and curves with it around the anterior end of the otic

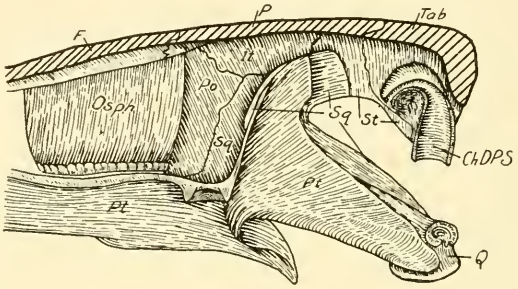

Fig. 8. Medial view of posterior portion of the right half of skull with the braincase removed. x 1.

notch. The quadrate ramus and ascending process of the pterygoid are continuous. The latter arises just behind the basipterygoid articulation to meet the descending process of the squamosal.

The articulation for the basipterygoid process of the basisphenoid is shown in its entirety in two fragments which bear the number 1090. It lies opposite the point where the quadrate ramus of the pterygoid joins the main body of the bone. The basipterygoid process fits into a fossa on the ventral side of the pterygoid. This fossa is crescentic in outline with rather high walls which project about 3 mm. below the ventral surface of the bone. The fossa is only about half closed over from its posterior edge.

The pterygoid with the exception of the quadrate ramus is completely covered on the palatal surface by shagreen teeth.

Epipterygoid. The epipterygoid was either absent or very small and lost, or may have been entirely cartilaginous. Nothing was found in any of the specimens which could be identified as this bone. This is

surprising, because in the Palaeozoic reptiles and amphibians it is very large.

In the type of *Conodectes favosus* Cope the epipterygoid is well developed. Although it will be described in another paper, I shall include it here for the sake of completeness. The epipterygoid is a broad plate of bone, placed more or less at right angles to the axis of the skull, on the anterior side of the anterior end of the quadrate ramus of the pterygoid just above the basipterygoid process. It is about 5 mm. wide and 20 mm. high, but lacks about 3 mm. of coming in contact with the parietal. It was probably continued in cartilage. On the medial edge about 3 mm. below the dorsal end is a short process which extends medially for a distance of about 2.5 mm. The lower part of the anterior side of the epipterygoid is so poorly preserved that it is impossible to determine whether or not it came in contact with the basipterygoid process. It is possible that the foot of the epipterygoid remained cartilaginous.

Ectopterygoid. The ectopterygoid forms only the anterior half of the flange of the pterygoid. Very little of the origin of the pterygoideus is on the ectopterygoid. Anteriorly the ectopterygoid joins the palatine, and laterally the maxillary. Dorsally it unites with a short stout process from the jugal. Posteriorly it has a very limited sutural union with the quadratojugal. It bears no large tusks but its palatal surface is covered with shagreen teeth.

Palatine. The palatine forms the posterior border and the posterior fourth of the lateral border of the internal naris. It joins the vomer and pterygoid medially, the ectopterygoid posteriorly, and the maxillary and lachrymal laterally. The lateral portion is very thick and massive for union with the maxillary and lachrymal. Just behind the internal naris is a pair of large tusks. Their size is equal to that of the posterior maxillary teeth. The palatal surface, with the exception of that in front of the palatine tusks, is covered with shagreen teeth.

Prevomer. The prevomer forms the medial boundary of the internal naris. It unites medially with its fellow and the pterygoid, and laterally with the palatine. It forms a very prominent ridge along the medial border of the internal naris. At the posterior end of this ridge is a pair of enlarged teeth of the same size as those on the palatine. Just behind the prevomer tusks is a broad U-shaped groove which leads into the posterior portion of the internal naris.

On the dorsal side of the prevomer is a V-shaped groove which lies above the ridge on the ventral surface (Fig. 9A). The medial limb of the V is the longer. Anteriorly the inclination is steep but it flattens

out posteriorly. The limb next to the internal naris is short and nearly vertical throughout the whole length of the groove. The posterior end of the prevomer is thickened and terminates abruptly in a nearly vertical slope. This slope is slightly rugose. It is possible that the pterygoideus anterior and the superior and inferior oblique

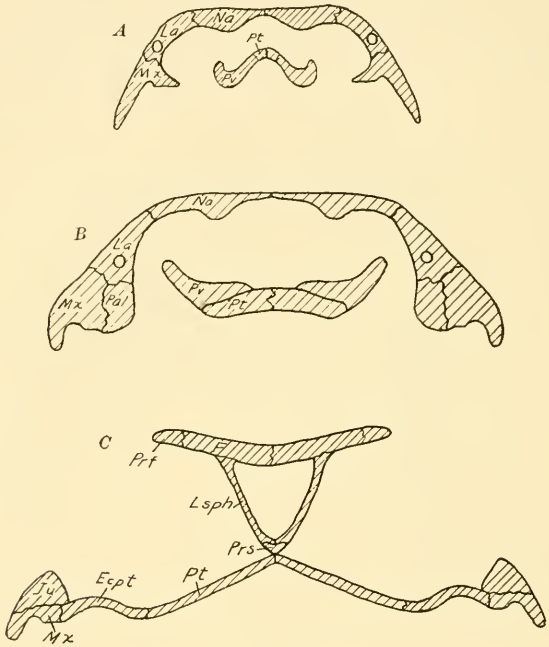

Fig. 9. Transverse sections of the skull. A, Immediately behind external nares. B, Through the posterior portion of internal nares. C, Through the middle of the orbit. x 1.

muscles of the eye had their origin on the posterior end of the prevomer.

Parasphenoid. The parasphenoid (Plate 1, Fig. A) is very small and has very few characteristics of the other cotylosaurs. It extends only a short way (15 mm.) in front of the hypophysial fontanelle and is rather broad in this region. It lies in contact with the pterygoids in front of the basipterygoid processes and helps close the interptergyoid vacuity. It lies below the pterygoids and does not pass upward be-

tween them as in other cotylosaurs. It is not constricted between the basipterygoid processes. Here the edges are curled downward by the processes so that the parasphenoid encloses a rather deep groove. Back of the basipterygoid processes it spreads out onto the otic capsule. It is not, as Watson (1918) states, fused with the proötic, but lies between the pro- and opisthotic on the ventral side of the otic capsule. The suture between the proötic and parasphenoid runs from the union of the pro- and opisthotics on the outer end of the otic capsule diagonally across to the top of the dorsum sellae. All specimens are broken in this region and it is not clear what the relationships were, but it seems that, with the parasphenoid fused with the basiphenoid, the former played an important part in tying the otic capsule to the basicranium anteriorly. There must have been a small gap between the basisphenoid and proötic which was filled with cartilage. The parasphenoid reinforced this cartilage. The downturned edges of the parasphenoid between the basipterygoidea pass smoothly into a pair of ridges which terminate in the tubera basioccipitalia. Here it enclosed a cartilage plug in each tuber. Between the tubera it continues for a short way on the basioccipital.

Presphenoid. The presphenoid is a slender Y-shaped bone which projects forward from the basisphenoid. The limbs of the Y lie on either side of the hypophysial fontanelle and the stem of the Y projects forward between the orbitosphenoids and the pterygoids (Fig. 10). In the hypophysial region it rests on the parasphenoid but is separated from it anteriorly by the pterygoids. In specimens Nos. 1081 and 1082 the presphenoid can be traced nearly to the anterior extent of the orbitosphenoids. The Y-shaped presphenoid shows us that *Seymouria* possessed a tropibasic skull.

Orbitosphenoid. The orbitosphenoid (Figs. 6 and 10) is a paired bone which occupies the interorbital region. It extends from the midline of the palate to the skull roof. Ventrally it is united to its fellow and to the pterygoid by suture; dorsally it is suturally united to the frontal. The distance between the orbitosphenoids is equal to one-half the interorbital breadth (Fig. 9 C). Postero-anteriorly they extend from the posterior border of the orbit nearly to the anterior border. I have found no foramina perforating them.

Basisphenoid. The basisphenoid (Plates 1 and 2) presents a condition intermediate between the Embolomeri and the cotylosaurs. The basipterygoid processes are well developed. They project laterally rather than ventrally as in other cotylosaurs. They are exposed ventrally as in the Embolomeri of the European Carboniferous (Watson,

1925). It seems highly probable that the "x-bone" which Watson (1918) described in his specimen is really the basipterygoid process of the basisphenoid. It could easily be interpreted as a separate bone since, although the parasphenoid is fused to the basisphenoid, the former is separated from the basipterygoid process by a deep groove which presumably receives the palatine branch of the internal carotid and the palatine branch of the seventh nerve. The dorso-lateral face appears to have been capped with cartilage for articulation with the pterygoid.

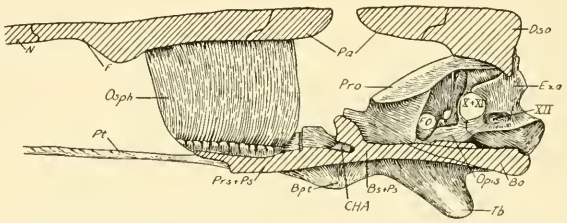

Fig. 10. Parasagittal section of skull showing a portion of the course of the internal carotid. x 1.

The dorsum sellae, when viewed from above, is shaped like a cupid's bow (Plate 1, Fig. B). The median septum which separates the two oblique eye muscles is quite large and prominent. It arises from the floor of the basisphenoid just behind the entrance of the internal carotids. The anterior edge of the septum is rounded and pillar-like. There is a rounded depression on either side of the septum which is continued onto the dorsum sellae. These depressions probably received the insertions of the oblique eye muscles. The septum is very thin between the depressions. Above the depressions the septum is abruptly expanded so that its upper end is more than twice as thick as the lower. The lateral ends of the dorsum sellae curve backward to meet the proötic. No suture can be determined in this region and all specimens are broken at this point. The parasphenoid is fused to the basisphenoid and furnished a bony support to the cartilaginous connection between the basisphenoid and the proötic. A thin sheet of the basisphenoid continues posteriorly from the dorsum sellae to the basioccipital and contributes to the formation of the tubera basioccipitalia. However, there undoubtedly was a large mass of cartilage on the floor of the braincase. Most of the upper portion of the dorsum sellae surely remained cartilaginous also, since the foramen for the sixth nerve is not shown.

Just in front of the median septum, which separated the oblique eye muscles, is an oblong depression which continues forward between the two limbs of the presphenoid. At the posterior end of this depression are the two foramina for the internal carotids. On each side of the depression is a high thin ridge which projects about 2 mm. above the floor of the basisphenoid. The internal carotid enters the basisphenoid just behind the basipterygoid process. It passes inward and slightly forward, then turns at nearly a right angle and passes forward and upward to the hypophysis (Fig. 10). An isolated basisphenoid bearing the number 1090 has been split longitudinally and polished. It shows the course of the artery from the hypophysis to a point nearly opposite the foramen behind the basipterygoid process.

Basioccipital. The basioccipital forms more than half of the transversely oval condyle. It is incompletely ossified, but the cartilaginous upper portion undoubtedly formed the floor of the foramen magnum. The ossification of the basioccipital does not extend dorsally beyond its union with the exoccipitals. It gradually becomes thinner anteriorly and terminates a little in front of the posterior edge of the tubera basioccipitalia. As near as can be determined the basioccipital did not contribute to the tubera. The cartilaginous plug which probably filled the parasphenoid sheath of the tubera lay between the basisphenoid and the opisthotic. I do not think the fact that the basioccipital plays no part in it is sufficient reason to change the name of this process.

In all of the specimens (Nos. 1081, 1082, 1084, and 1086) in which the basicranium is preserved, the anterior end of the notochordal sheath is shown as a small spindle-shaped rod 7 mm. long and 1½ mm. in diameter. It extends from the notochordal pit to the anterior end of the basioccipital. There seems to have been a small amount of ossification in the notochordal sheath in all of the specimens. It appears as an extremely thin sheet of bone around the notochord.

Exoccipital. Specimen No. 1084 is the only one in which a complete exoccipital was preserved. The skull had been rather badly crushed and the right exoccipital was jammed in between the otic capsule and the descending process of the dermosupraoccipital. After some days of careful work with a needle, under a microscope, it was freed in its entirety.

The exoccipital (Plates 1 and 2) is greatly expanded at both ends while the shank is relatively slender. The lateral side of the bone is nearly straight. The anterior edge is deeply notched by the foramen for the tenth and eleventh nerves. It forms the superior, posterior,

and inferior borders of this foramen. The medial side is excavated by the foramen magnum. The two exoccipitals very nearly bound the foramen magnum. The expanded lower ends lack 4 mm. of meeting in the midline. The expanded upper ends were somewhat farther apart. It is impossible to measure the distance which separates them exactly because of crushing and disarrangement. As near as can be calculated the upper ends of the exoccipitals lacked approximately 7 mm. of meeting in the midline. The intervening space was probably filled with cartilage.

From the edge of the condyle the exoccipital passes inward and upward for a short distance and then turns upward to meet the opisthotic. On the posterior side close to the upper end near the median edge is a small facet for the proatlas. This facet is directed posteriorly and slightly laterally. Near the middle of the dorsal surface of the expanded upper portion is a slight reëntrant which fits a corresponding angle on the opisthotic.

Near the lower end of the exoccipital is a small foramen for the escape of the twelfth nerve. It enters the bone near the bottom of the foramen magnum, and comes out a little below its entrance.

Supraoccipital. No distinct supraoccipital is present in any of the skulls. Watson reports an ossification in the supraoccipital region of *Conodectes favosus* Cope.

Otic Capsule. The otic capsule (Plates 1 and 2, and Fig. 10) is represented by very thin perichondral bone which is divisible into proötic and opisthotic portions by well-defined sutures on the top and bottom. So little ossification has taken place that it is impossible to work out the semicircular canals satisfactorily. One of the peculiar features of the otic capsule is that the stapes has been enclosed in a channel by the parasphenoid, the proötic, and opisthotic. As far as I know *Seymouria* is the only Palaeozoic tetrapod in which this occurs. A parallel condition is found in *Rana.*

Both the proötic and opisthotic are attached to the tabular through the upper end of the hyoid. A well-defined groove to receive the hyoid traverses the upper portion of the lateral end of the otic capsule. This is opposite a similar groove on the tabular. Through the hyoid the otic capsule is securely bound to the skull roof and furnishes a strong support between the latter and the basicranium. This support is ordinarily termed the "paroccipital bar" but in nearly all reptiles the process is made up entirely of the opisthotic. In *Seymouria* the proötic and opisthotic contribute equally to its formation. Since the "paroccipital bar" is made up of these two elements in this primitive

tetrapod, it seems likely that the proötic originally formed a portion of the strut between the basicranium and the skull roof. The very broad "paroccipital bar" in *Palacogyrinus* and *Eogyrinus* would seem to support this view. In *Captorhinus* the proötic has receded a short way from the outer end of the "paroccipital bar." In the pelycosaurs and other reptiles it plays little or no part in the formation of this process. Thus it is evident that the proötic ceases to contribute to the "paroccipital bar" relatively early in the history of the tetrapoda.

Proötic. The proötic portion is suturally united with the parasphenoid. It is impossible to determine whether or not the proötic is distinct from the basisphenoid because all of the specimens are broken through this region. Since the proötic is distinct from the parasphenoid from the former's union with the dorsum sellae, it seems likely that the basisphenoid and proötic are distinct. Watson (1918, Fig. 1) evidently interpreted the posterior extension of the parasphenoid as the basisphenoid.

There are two foramina (Plate 2, Fig. A) on the anterior face of the proötic. The medial one is the larger and marks the exit of the facialis branch of the seventh nerve. The smaller lateral foramen is for the hyomandibularis branch of the seventh. The median end of the proötic is notched by the fifth above the dorsum sellae. The lateral end of the proötic is deeply incised about its middle by a U-shaped groove which disappears in the region of the hyomandibularis nerve exit. Near the lateral end of this groove a small cylindrical process extends nearly across it from the dorsal rim. This groove was probably a passageway for the *vena capitis lateralis*, stapedial artery, and the hyomandibularis branch of the seventh nerve. On the dorsal side of the proötic, about the region of the superior semicircular canal, is a rounded ridge which extends antero-posteriorly. Within the otic capsule this ridge is hollowed out and it probably housed the superior semicircular canal. The other canals cannot be identified. The posterior end of this ridge lies on the inner end of the opisthotic and unites suturally with the dermosupraoccipital at the edge of the thickened area of the latter. As far as I know *Seymouria* is the only tetrapod in which the proötic articulates with the dermosupraoccipital. It does not seem unreasonable to correlate this character with the absence of a bony supraoccipital.

Opisthotic. The opisthotic forms the posterior half of the otic capsule and the anterior borderof the foramen for the tenth nerve. Its median end is the heaviest and strongest. The ventral side bears two facets. The anterior one abuts against the basisphenoid at the tubera

basioccipitalia. The posterior one abuts against the side of the basioccipital. There are three facets on the posterior side, a ventral, a medial, and a dorsal. The ventral and a part of the medial facet receive the upper end of the exoccipital. The remainder of the medial face received the cartilaginous supraoccipital. The dorsal facet received the posterior projection of the proötic. The opisthotic is united by suture to the occipital flanges of the tabular and the dermosupraoccipital.

The paroccipital portion unites with the posterior flange of the hyoid groove of the tabular by an overlapping suture. This is shown best in No. 1086. Thus the thin slit of the posttemporal fenestra is bounded only by the opisthotic and the tabular. It seems reasonable that the condition in *Seymouria* should represent the primitive condition in the tetrapoda.

The above consideration of the braincase shows that on the posterior surface of the skull we have three paired lines of support between the basicranium and the skull roof (Fig. 5). Numbering them from the median to the lateral, number one passes from the basioccipital through the exoccipital and cartilaginous supraoccipital to the dermosupraoccipital. Number two passes from the basioccipital through the exoccipital and the median end of the opisthotic to the heavy descending process of the median end of the tabular. Number three passes from the basioccipital through the paroccipital process to the lateral end of the tabular. These lines are traceable but somewhat modified in *Captorhinus*.

Stapes. Only a very small amount of ossification has taken place in the stapes. It is represented by a cylindrical rod about 11 mm. long. This rod probably represents only the central portion of the stapes, the medial and lateral ends remaining cartilaginous. The median end passed through a canal along the antero-ventral side of the otic capsule to the foramen ovale, which lies just above the tubera basioccipitalia. The foramen ovale is bounded by the proötic and opisthotic. In this respect *Seymouria* is very different from the other cotylosaurs.

Sclerotic Plates. In skull No. 1087 the sclerotic plates in the left orbit are preserved. The ring of plates has been disturbed somewhat and the exact number cannot be determined, but it was probably about twenty. The outside diameter of the ring is about 19 mm. and the inside diameter is 9 mm. The antero-posterior diameter of the orbit is 25 mm. The plates are quadrangular in outline and nearly twice as long as wide. There are three plates in what appear to be normal arrangement. Only the middle one is complete enough to be meas-

ured. The width at the inner end is 2 mm. and at the outer 2.5 mm. The amount of overlap cannot be determined. The length of the plate is 5 mm.

The Lower Jaw

I have only minor details to add to Watson's (1918) analysis of the lower jaw. It will be considered fully here for the sake of completeness.

The left lower jaw (Fig. 11 A and B) belonging to skull No. 1083 is

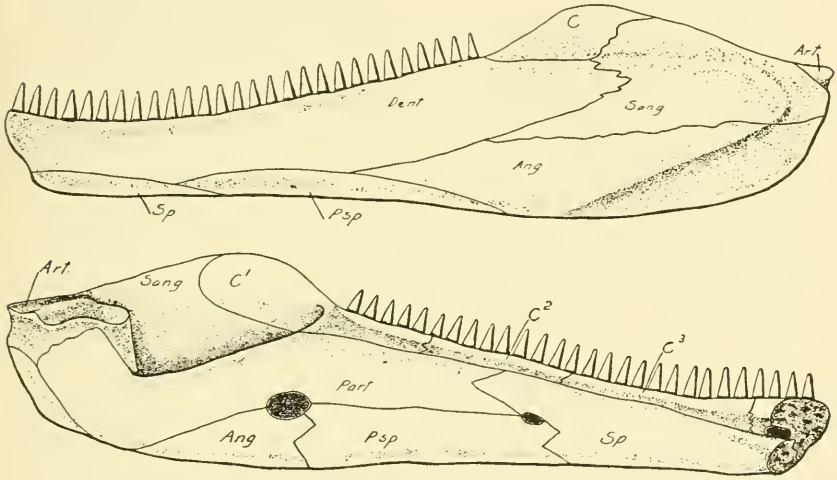

Fig. 11. Views of lower jaw. A. lateral and B medial aspects. x 1.

nearly perfect. In addition there are five imperfect lower jaws belonging to other individuals, supplementary fragments and isolated bones.

Articular. A right articular, No. 1090, has been freed by preburial maceration. It is roughly tetrahedral in shape. The upper surface bears two facets which correspond to the lobes of the quadrate. The larger is on the outside. Between the two facets is a low ridge which is directed forward and a little outward. The outer side is deeply indented by the union with the surangular. The medial side is less deeply indented by the suture with the prearticular. The anterior face is flat and was probably joined by Meckel's cartilage. On the posterior side of the articular between the surangular and prearticular is a small rugose area for the insertion of the retractor mandibuli.

1. Fore wing with a silver dash beyond cell, along lower edge of M_2; terminal space crossed by diagonal white lines (representing the adterminal line); ground dark 2
   Two oblique silver stripes in antemedial region and conspicuous brilliant bronzy areas . . . . . *Lysana plusiata*
   Fore wing without silver postmedial or antemedial stripes; terminal area without oblique lines; ground pale with dark oblique shade and st. spot 3
2. Silver bar thick, free at basal end; a smaller species with dorsal plume on antenna and hind tarsus close-scaled . . . . . *arema*
   Silver bar fine, connected to an oblique white patch at middle of costa; no dorsal plume; male hind tarsus with hairy tufts. *marmorea*
3. A thick brown-black bar from costa near base over M_3 and Cu_1 to margin; ground yellowish . . . . . *contingata*
   This bar thin and shading into the ground below, defined only on upper side 4
4. Ground shaded with reddish . . . . . *rufescens*
   Ground light gray . . . . . *joeasta*

Calledema marmorea Butler (Fig. 31)

C. marmorea Btl. Trans. Ent. Soc. Lond. 1878, 65; Schaus Trans. Ent. Soc. Lond. 1901, 264 (in list only); Dyar Proc. U. S. Nat. Mus. xlvii, 223, 1914.
Figured: Seitz 143: a1.
(Omitted from Lep. Cat.).

Antennæ with dorsal scaling of scape only about twice as long as ventral, not forming a true plume; fore wing with M_1 and M_2 approximate for a distance near origin, then diverging; hind tarsus with tufts on first two segments. Genotype of *Calledema*.

Ground mouse gray. *C. sodalis* Btl., described by Butler in the same paper, is almost identical in pattern but has the high tuft and divergent M_1 and M_2 of Pseudantiora, also a close-scaled hind tarsus.

Late Nov.–May (see diagram, p. 245). Guatemala to Amazons and Espirito Santo, Brazil.

Calledema arema Schaus

C. arema Schs. Proc. U. S. Nat. Mus. xxix, 231, 1906.
Figured: Seitz 143: a4.

Acc. cell extending almost half way to apex; plume of antenna high; M_2 well below angle of cell; hind tarsus close-scaled.

Small with strongly contrasting silver bar,—without the bronze areas of *L. plusiata*, but with some yellowish silver before the antemedial tuft.

Feb. 3-June 23 (see diagram). Costa Rica to Guiana (type) and Upper Amazons.

Calledema jocasta Schaus

C. jocasta Schs. Trans. Ent. Soc. Lond. 1901, 264.
Figured: Seitz 143: a5 (head and prothorax should be dark and contrasting).

Plume strong, M_2 from close below angle of cell, diverging; hind tarsus with long hair on basal segments; acc. cell short (as in the following spp.). R_2 usually stalked, M_1 about 1/3 way out on acc. cell. Light gray.

Feb. 14, 22 (Weeks, A.M.N.H.) 23 (Bts.) Mar. 3 (Fried.). Guatemala to Rio de Janeiro, common on the Amazon.

Calledema rufescens Schaus

Pseudantiora rufescens Schs. Proc. U. S. Nat. Mus. xxix, 235, 1906.
Figured: Seitz 144: h6.

R_2 short-stalked, M_1 from base of acc. cell. Large, the fore wing decidedly redder below the diagonal line than above.

Dec. to June (see diagram). Guatemala to Guiana and Amazons.

Calledema contingata Möschler

Antiora contingata Msch. Verh. z.-b. Ges. Wien xxxii, 347, 18: 35; 1883.
Also *figured:* Seitz 144: h5.

R_2 variable; M_1 from acc. cell at 1/3. This is the genotype of Pseudantiora. The brown ruptive pattern on a grayish yellow base is distinctive.

Dec. 31, 1934 (Fried.). Ranges to Guiana and Santa Catharina, Brazil.

Dyar reports *Lysana plusiana* Schs. from the Canal Zone. The antennæ are heavily serrate, plume enormous; it is small, brown, brilliantly marked with lilac gray, copper, and silver lines.

Elymiotis Walker

Similar to the preceding genus, but with inconspicuous lichen-like pattern, sometimes with green. Fore wing narrower; plume rudimen-

smooth, short blunt-ended backwardly directed processes forming its lateral margin. The upper surface of this bone has laterally two large flat triangular areas for articulation with the neural elements; between these areas the anterior end of the bone is excavated into a conical pit, only half of which is present, but which resembles exactly that in the end of an ordinary centrum.

"One pair of other elements is preserved. Each of these has a high laterally compressed but antero-posteriorly elongated neural spine, whose posterior margin descends directly to the hinder end of a well-formed posterior zygapophysis. The anterior margin of the spine descends vertically about to the level of this articular face, and then turns forward so as to lie horizontally and form the upper edge of a squarish area of bone whose front edge is rounded and articular and of considerable width. The lower part of this region ends in a short blunt point. It is obvious that the neural spines of the pair of elements lay in contact with one another and that the zygapophyses were supported by those of the succeeding vertebra. The anterior end could have articulated with the exoccipital part of the condyle, the intercentrum supporting the basioccipital part.

"The odontoid is a single bone. Its upper surface is slightly rounded but presents no trace of any articulation. The posterior surface is not exposed. The anterior surface is slightly convex, rising to a small point. This surface is in general triangular with the point at the mid-ventral surface. The lateral edges are slightly emarginate at about the middle of their height so as to divide the whole area into three; of these, the lowest articulates with the anterior intercentrum, and the two dorsal with the neural arches. The lateral surface is nearly flat, but rises somewhat towards the ends; it is triangular, so that there must be a gap for a triangular intercentrum between the odontoid and the axial centrum."

One specimen (M. C. Z. No. 1646) contains the atlantal intercentrum, one half of the neural arch with upper portion of spine missing, axial intercentrum, axis and third vertebra with intercentrum in a connected series. The odontoid is missing. These vertebrae appear to belong to an immature individual, as the neural arches are not securely ankylosed to the centra. This specimen is peculiar in that neither the neural arch nor the intercentrum of the atlas bear articulations for an atlantal rib. This is unusual because atlantal ribs are present in all other primitive reptiles. Otherwise the atlas agrees with Watson's (1918) description and figures. The portion of the neural arch preserved possesses a well developed facet for the proatlas. The axial

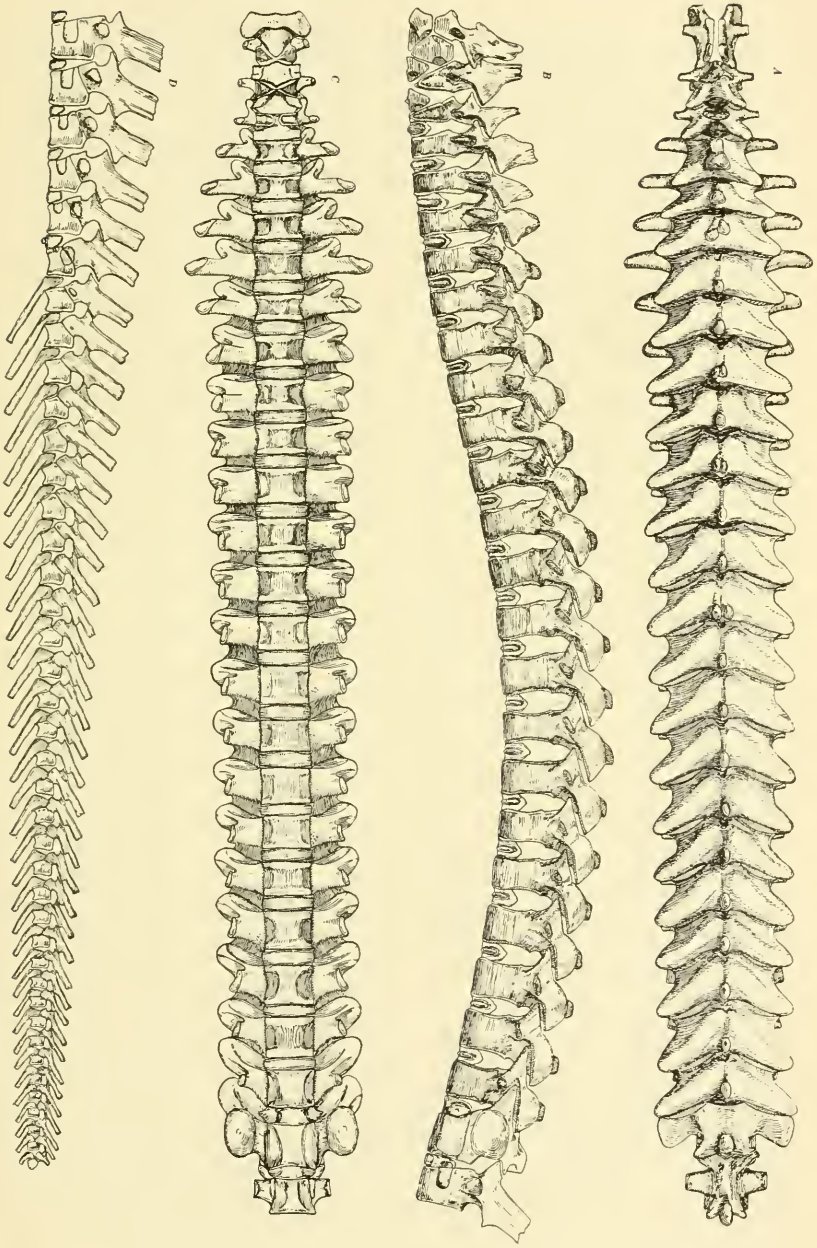

Fig. 12. Vertebral column, A, dorsal; B, lateral, C, ventral views of presacral vertebra; D, lateral view of caudal vertebra. x ½.

intercentrum is rather broad antero-posteriorly and with very little curvature. The median portion of the posterior edge is produced backward in the same manner, but to a lesser degree, as the atlantal intercentrum. At the lateral ends and near the posterior edge is a facet for the articulation of the capitulum of the rib. The facet is a little smaller than that of the transverse process. Just medial to the facet is a small tubercle. The antero-posterior dimension is 5.5 mm. The lateral ends do not curve upwards much beyond the facet for the rib end.

There are two specimens of the axis in the M. C. Z. material, one (No. 1645) belonging to an old individual, and the other to the forementioned series. The neural arch of the axis does not differ greatly from that of the atlas, except in the possession of well developed anterior zygapophyses, and in being a single element. So close is the resemblance that if the prezygapophyses were broken away it might easily be mistaken for the neural arch of the atlas. In the axis of the mature individual, the neural arch is securely fused with the centrum so that the division between the two cannot be determined. In the younger specimen the neural arch and centrum have become separated. In both specimens the centrum is incomplete ventrally, resembling the centrum of the atlas in this respect (Fig. 12, C and D).

The intercentrum of the third vertebra has about the same antero-posterior dimension as that of the axis and is without much curvature. The posterior edge is nearly straight and the anterior edge projects forward in the midline in the same manner as the preceding one projects backward. The facet for the capitulum of the rib is somewhat larger than the preceding. Just medial to this facet is a well defined tubercle.

The neural arch of the third vertebra is as high as the preceding but is not elongated antero-posteriorly. This is the only feature in which it differs from that of the preceding vertebra. The centrum is very short antero-posteriorly. The dimension of the upper portion is nearly twice that of the ventral border. Of the two specimens at my disposal, the finished surfaces of the sides are continuous ventrally in one and not in the other.

These three vertebrae have very large neural canals, the diameter of which equals two thirds that of the centrum. The neural canal of the fourth vertebra is somewhat smaller, and that of the sixth is the same as that of the rest of the column.

Anterior Dorsal Vertebrae. The next six vertebrae are characterized by greatly elongated diapophyses and shorter centra than the succeeding vertebrae. The diapophysis extends laterally beyond the zygapophy-

sis and is rather robust. That of the fourth vertebra is only a little longer than that of the third, the fifth longer than the fourth, etc., till the maximum length is reached in the seventh. That of the eighth is shorter than the seventh and the ninth shorter than the eighth, extending only a little way beyond the zygapophysis. It seems probable that these ribs supported the scapular arch. In most reptiles the ribs beneath the scapula are stronger and heavier than the others.

The neural arch becomes progressively expanded in these six vertebrae. That of the fourth vertebra is only a little larger than that of the third and the neural spine is just as high. The neural arch and spine of the ninth vertebra are not appreciably different from those of the tenth, which is normal for the rest of the column. The transition from the fourth to the ninth is uniform and gradual.

The centra increase in length and diameter from the fourth to the ninth. The length of the fourth is but little greater than that for the third, and the length of the ninth is equal to that of the tenth. The centra of the anterior vertebrae of this series are nearly triangular in cross section if taken at the midlength. The cross section becomes more nearly circular posteriorly.

The anterior intercentra are somewhat larger than the posterior ones in these vertebrae. Those of the fourth to seventh vertebrae are nearly straight across ventrally. The eighth is curved somewhat and the ninth has nearly assumed the form normal for the rest of the column.

Posterior Dorsal Vertebrae. The vertebrae from the tenth to the twenty-second differ very little from one another. In all, the neural spine is very short and apparently with a cartilaginous termination. This cartilage could not have extended the spine more than one or two millimeters because the bone is considerably constricted at the upper end. Most of the spines are single but some of the spines are bifid with the two halves nearly equal. In others, a division is indicated by a small spur on the side. There seems to be no regularity of the occurrence or position of the bifid spines.

The neural arch bears the expanded and swollen zygapophyses for which *Seymouria* is noted. There is no appreciable change in their form from the tenth to the twenty-second. The diapophyses present the only change seen in the series. That of the tenth is triangular in section. That of the eleventh is elliptical in section with the long axis of the ellipse extending from antero-ventral to postero-dorsal. This oblique position of the diapophysis decreases posteriorly till that of the seventeenth vertebra lies nearly horizontal. This position is normal for the rest of the series.

The nearly cylindrical centra of these vertebrae are without features to distinguish them from one another. The posterior centra are slightly longer and the diameter is somewhat greater.

The intercentra are half-rings of the same diameter as the vertebral centra. The facet for the capitulum of the rib lies about the middle of the height of the vertebral centrum and projects laterally about one mm. from the curve of the intercentrum. The bone is usually produced upward a little beyond the finished surface of the outside.

"*Lumbar*" *Vertebrae.* The last two vertebrae in front of the sacrum are somewhat different from the preceding. The neural spines are somewhat higher and the zygapophyses are not so broad. The anterior zygapophyses project farther in front of the centrum than in the preceding vertebrae. The facet for the tubercular head of the rib is placed lower down on the neural arch and is smaller. The facet of the twenty-third vertebra is still elliptical in outline but that of the twenty-fourth is nearly circular. The centra and intercentra do not differ essentially from those of the preceding vertebrae.

Sacral Vertebrae. There are two specimens (Walker Museum No. 165 and M. C. Z. No. 1097) in the material studied which show that the vertebra heretofore considered as the first caudal is actually a second sacral. The rib of the second sacral comes in contact with the inner side of the greatly expanded rib of the first. Doubtless it was connected by a strong band of cartilage in life and was a functional second sacral vertebra.

The first sacral vertebra bears the transition from the greatly expanded zygapophyses of the dorsal vertebra to the normal ones of the caudal series. The neural spine is somewhat higher than that of the last presacral. In one specimen the neural spine is bifid. The prezygapophysis is greatly elongated antero-posteriorly so that the anterior edge lies above the diapophysis of the one in front. This forward extent is partially a compensation for the very large facet for the tubercular head of the rib. This facet has a diameter fully as large as that of the centrum. Its anterio-posterior diameter is a little greater than the vertical. The facet for the capitular head of the first sacral rib has a greater antero-posterior extent than that for the tubercular head, but the vertical extent of the former is less than that of the latter. They are separated by a small groove which probably carried the vertebral artery. The anterior portion of the facet for the capitular head is borne by the intercentrum. Posteriorly this facet extends nearly to the posterior end of the centrum. The postzygapophyses are a little less than half as wide as the prezygapophyses. The neural

canal is somewhat larger than that of the dorsal series, as also is that of the second sacral and the first caudal. The centrum is nearly flat on the bottom side and is without the slight constriction which is seen in the presacral vertebra.

The intercentrum of the first sacral is very heavy and robust. The antero-posterior dimension is nearly twice that of the dorsal intercentra. There is a low moderately broad median ridge on the ventral surface. The anterior edge of the facet for the capitular head of the rib projects laterally about 1.5 mm. beyond the vertebra in front. The anterior edge of this facet is quite straight, but the posterior edge slants posteriorly to meet the centrum of the first sacral vertebra. The capitular head of the sacral rib articulates with this sloping surface.

The second sacral vertebra differs from the first in that the neural arch is not expanded. The neural spine is high and strong. The zygapophyses are of the same width as the posterior zygapophyses of the first sacral. The facets are nearly horizontal, sloping very little. The diapophyses are very strong, subcircular on the end, and project a little way beyond the zygapophyses. The facet for the capitular head of the rib is borne by the centrum and intercentrum. The facet extends forward from about the midlength of the vertebra. The centrum has the same diameter as that of the first sacral. On its ventral surface it bears a low broad ridge. The intercentrum is similar to that of the first sacral but is shorter antero-posteriorly and is not as broad.

Caudal Vertebrae. There is not a complete series of caudal vertebrae at my disposal. The best series is a specimen of *Conodectes favosus* Cope (U. S. N. M., No. 9140) which has the last ten dorsals, the sacrals, and the first twelve caudals in a continuous series. In addition, the material collected by Dr. Olson and the material in the M. C. Z. contain several short series of vertebrae from various parts of the tail. One of these series (M. C. Z., No. 1648) is very near the end of the tail, but lacks one or two terminal vertebrae. By measuring the first and last centrum of each of these short series I was able to obtain the amount of decrease in size of the vertebrae for the different parts of the tail. With the data thus obtained I have attempted a restoration which, it is hoped, will fall within the limits of plausibility. In most recent reptiles which are moderately active, whether aquatic or terrestrial, the length of the tail is nearly equal to the length of the body without the head. Such a tail in *Seymouria* would contain about forty vertebrae.

The first four caudal vertebrae resemble the sacrals and dorsals in

that the neural arch is securely ankylosed to the centrum. In the remainder of the vertebrae the two are separate. As Watson (1918) found in his material, the first six vertebrae bear ribs with a large capitular head which articulates with both centrum and intercentrum. The articulation on the centrum for the capitular head of the rib does not extend posteriorly beyond the midlength of the centrum. The facet for the articulation of the tubercular head of the rib is borne by the neural arch in the first four vertebrae and by the neural arch and the centrum in the fifth and sixth. In one specimen collected by Dr. Olson (W. M. No. 166), the seventh and eighth vertebrae bear short transverse processes but no ribs. The other specimens do not show this feature. The remaining vertebrae are without any trace of a transverse process.

Beginning with the fifth or sixth vertebra the neural arch appears to slide farther and farther forward on the centrum till in about the last twenty-five vertebrae the neural arch articulates posteriorly with the centrum and ventrally with the intercentrum. This condition is essentially the same as that in the tail of the embolomerous Amphibia. From the first vertebra, the neural spine leans more and more steeply backwards till in the sixteenth it makes an angle of about 60° with the top of the centrum. This angle is maintained in the rest of the vertebrae.

The centra of the anterior caudal vertebrae are more or less cylindrical or only slightly constricted at their midlength. Posteriorly they tend to become more and more hourglass shaped. The change is a gradual one. The posterior vertebrae are more deeply constricted at the sides than at the bottom. In these the length of the bottom is considerably less than that at the middle of the height. The top of the centrum is entirely free of the neural arch and has a length equal to that of the bottom. The face for the articulation of the neural arch occupies the dorsal half of the anterior end and slopes downward and forward at a very steep angle.

The intercentra of the anterior caudal vertebrae are about the same as that of the second sacral. The actual increase in antero-posterior length is negligible, but the relative increase is such that at about the middle of the tail the length of the intercentrum is equal to that of the ventral side of the centrum. In the forementioned specimen of *Conodectes favosus* Cope (U. S. N. M., No. 9140) the intercentrum of the sixth vertebra bears two short backwardly directed processes on the ventral surface which represent the first haemal arch. The sixth vertebra, as in the specimens studied by Profs. Williston and Watson, is the last vertebra to bear a rib. In the material which Dr. Olson

collected (W. M., Nos. 166 and 167) the haemal arches begin with the last vertebra to bear a rib. Williston states (1911, p. 55) that a haemal arch is present on the intercentrum of the fourth caudal vertebra. If we subtract the vestigial second sacral which he considered the first caudal, the haemal arches begin with the third intercentrum. Watson (1918) does not state which intercentrum carries the first haemal arch, but in his restoration he places it on the fourth. Correspondingly the chevrons would begin with the third as in Williston's specimen. With the chevrons beginning with the third vertebra on the specimens formerly studied and with the sixth in the material at my disposal it seems probable that the same skeletal differences existed between the sexes in *Seymouria* as we find in the *Testudinata* and *Loricata*. Also, the males possessed a single intromittent organ because the paired hemipenes of lizards and snakes do not alter the disposition of the chevrons between the sexes. In view of this, the skeletons studied by Profs. Williston and Watson were females and those collected by Dr. Olson were males. The material in the M. C. Z. was completely disarticulated and any attempt to determine the sex would be futile. With this skeletal difference between the sexes we are obliged to postulate internal fertilization and large yolked eggs for *Seymouria*. With large yolked eggs the young would have come into the world as competent to live in the environment of their parents as are the young of Recent reptiles.

Cervical Ribs. (Fig. 13.) The rib of the first vertebra is not identifiable in the material at my disposal. Of the atlantal rib Watson (1918, p. 280) says: "The long slender *atlantal* rib is double-headed, the capitulum and tuberculum being carried at the ends of two widely separated branches." In his illustration (Fig. 9, p. 280) he shows the distal end as slightly expanded and the necks of the capitulum and tuberculum as nearly equal in length.

A specimen in the United States National Museum (No. 9140) shows the second and third ribs expanded distally in the same manner, but to a lesser degree, as the fourth. The distal ends were exposed to the weather for some time before they were collected, and reliable measurements cannot be taken. Nor can the exact nature of the capitular and tubercular heads be determined, but there seems to be a gradual transition in the form of the ribs from the first to the fourth.

Anterior Dorsal Ribs. (Fig. 14.) There is in the material in the M. C. Z. (No. 1642) a series of five ribs from the left side cemented together in such a manner that it seems probable that they are adjacent elements. The posterior side of the first of the series is applied to

the anterior side of the second, and the posterior side of the second to the anterior side of the third, etc. As near as could be determined by measuring the tubercular heads of the ribs and the diapophyses of the vertebrae the ribs belong to the fourth to eighth vertebrae inclusive.

The capitular and tubercular heads of the fourth rib are separated by a deep notch. The neck of the capitular head is longer than that of the tubercular, and not subequal to it as Watson (1918, Fig. 9, p. 280) shows for the first. In the succeeding ribs the notch between the two heads becomes more and more shallow till it is nearly obliterated in the

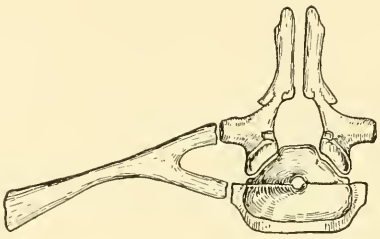

Fig. 13. Atlas and atlantal rib, anterior aspect, based upon Watson's text and figures. x 1.

eighth. The increased shallowness is accompanied by an increase in the length of the neck of the capitular head and a decrease in that of the tubercular head till in the eighth rib the tubercular head is only a protuberance on the shank of the rib. In all of the ribs the articular facets of the capitular and tubercular heads are slightly excavated and were undoubtedly finished in cartilage.

The fourth rib is rather short with a greatly expanded distal end. The length along the upper edge from the tubercular head to the distal end is 29 mm. and the width is 17.5. The fifth has a length of 31 mm. and a width of 21 mm. The sixth is 34 mm. long and 19 mm. wide, the seventh 37 mm. long, 14 mm. wide, and the eighth 38 mm. long and 9 mm. wide. Each rib bears a short shank just lateral to the union of the capitular and tubercular heads. The shank is crescentic in cross section with the long dimension in the vertical plane. This dimension is about equal to the vertical diameter of the capitular head. There is a gradual increase in depth of the rib from the shank to the greatly expanded distal end. In the expanded part of the rib the lower portion, about equal to the shank in thickness, is nearly twice as heavy as the remainder. It seems probable that the heavier lower portion

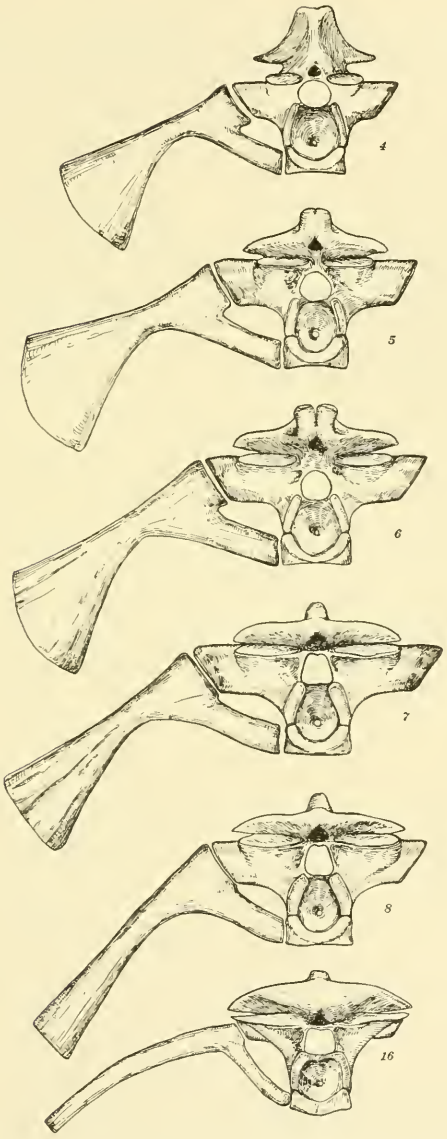

Fig. 14. Anterior aspect of fourth to eighth, and the sixteenth dorsal vertebrae. x ⅔.

represents the primary rib, and that the remainder is a later specialization, probably for a better insertion of the serratus muscles. The distal end of all of these ribs is excavated and undoubtedly finished in cartilage.

The capitular and tubercular heads lie in the same plane as the expanded distal ends. Consequently the latter could not have overlapped as thought by Williston (1911, p. 55), but occupied a nearly vertical position in the body, tilting only slightly backward. Because of the straightness of the scapula and the position of the expanded rib ends in relation to the body the scapula could not have overlain the ribs in the normal manner but must have abutted against their outer ends.

The rapid increase in the length of the fourth to the seventh ribs and the diapophyses of the accompanying vertebrae would give *Seymouria* a short but distinct neck. The angle which a plane applied to the outer ends of the fourth to seventh ribs makes with the axis of the body is essentially the same as that made by the scapula, whose position is determined by the clavicle. Consequently there can be little doubt but that these ribs supported the scapula.

Of the succeeding ribs only the sixteenth (U. S. N. M. No. 9140) is complete enough for description. It has been somewhat deformed by dorso-ventral crushing but fragments of other ribs indicate that the curvature of the ribs in this part of the body was less than that in the thoracic region. The capitular and tubercular heads are farther apart than on the anterior dorsal ribs. The tubercular head is only a protuberance on the shaft with the articular facet sloping upward and outward from the neck of the capitular head. The shaft of the rib is subcircular in cross section, slightly deeper than broad. It is deeper proximally than distally. The distal end is excavated and undoubtedly finished in cartilage.

Sacral Ribs. The first sacral rib is heavy and robust. The tubercular head is the larger and its articular face is circular in outline. Its diameter is only a little less than that of the centrum of the vertebra. It is separated from the capitular by a narrow groove for the passage of the vertebral artery. The capitular head is elongate antero-posteriorly with the articular face rectangular in outline. The length is twice the height. From the two heads the rib passes abruptly into the expanded blade-like distal portion which fits (Figs. 15 A and B) the inner side of the blade of the ilium. The blade of the rib is somewhat broader than deep and is nearly parallel to the vertebral axis. Its antero-posterior dimension is 24 mm. and the dorso-ventral is 21 mm.

at the anterior end of the blade. It occupies a nearly vertical position, the bottom inclined slightly outward. The median portion is very thick and robust but gradually becomes thinner anteriorly and posteriorly. On the mesial side is a broad low median ridge which passes

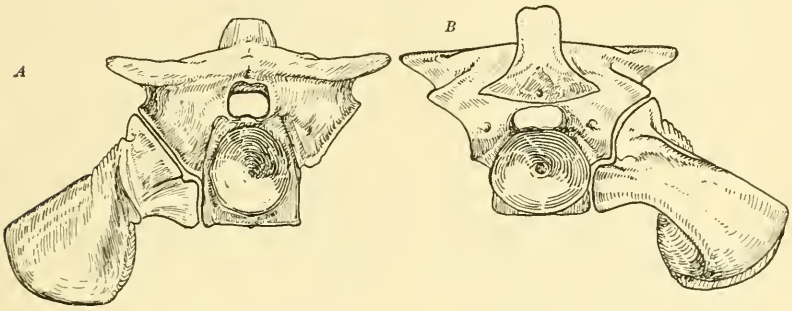

Fig. 15. First sacral vertebra and rib. A, anterior and B, posterior aspect. x 1.

smoothly into the neck of the capitular head. The posterior portion of the blade of the rib is curved outward somewhat. The lower edge of the rib is about 3 mm. thick and was evidently continued in cartilage. The insertion of the ilio-sacral ligament forms a well defined

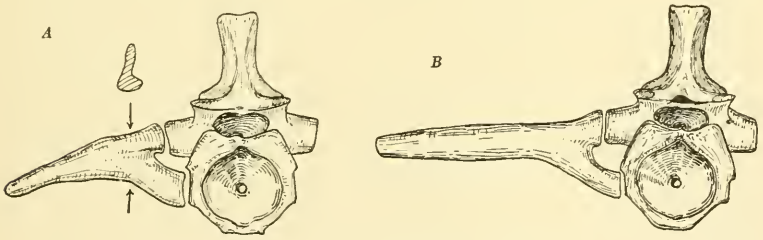

Fig. 16. Anterior aspect of A, second sacral and B, first caudal vertebra and rib. x 1.

scar which runs obliquely, from antero-dorsal to postero-ventral, across the top of the blade just below the tubercular head.

The second sacral rib (Fig. 16A) is much smaller and more closely resembles the succeeding caudals than it does the first. The capitular and tubercular heads do not differ except in size from those of the suc-

ceeding caudals. The capitular head articulates with both the centrum and intercentrum.

The rib has a length of 22 mm. from the tubercular head to the distal end. It is slightly curved backward so that, as near as could be determined, the outer end of the rib would be applied to the posterior edge of the blade of the first and probably also to the ilium. There is no indication that this union was a strong one. The rib gives the impression of being an atrophying element.

Like the anterior dorsal ribs the lower border of the second sacral is rather thick and strong and the upper portion is thin and weak. The rib diminishes rather rapidly in depth from the proximal end. One specimen, which seems to be a young individual, lacked the thin upper portion. In view of this it would seem that the lower portion represents the primary rib and the upper part is secondary. The thin upper portion extends outward from the tubercular head for about two thirds of the length.

Caudal Ribs. The first caudal rib (Fig. 16B) is longer and stronger than the second sacral. It is compressed antero-posteriorly and diminishes in depth and thickness from the proximal end outward. The whole rib is curved slightly so that the distal end lies a little posterior to the proximal. It has a length of 30 mm. measured along the upper edge. The length and curvature would bring it very close to and possibly in contact with the posterior process of the ilium. Perhaps it should be considered a third sacral rather than the first caudal. According to Watson's (1926) analysis of the embolomerous Amphibia of the Carboniferous of England the ilium was supported by three ribs. The ilium lay on these ribs in the same manner as the scapula and was attached to them by muscles. Whether or not these ribs can properly be called sacrals is purely an academic question and I see no objection to Watson's use of that term for these elements. That some or all of these ribs should become securely ankylosed to the ilium without doubt filled a great need for additional strength and rigidity in this region of the body, as the animal became more and more terrestrial. There is not sufficient data at present to trace the course of development of the sacrum but it seems probable that the three ribs and vertebrae kept pace with each other for a time. Later, in some lines, the first gained the ascendency in development and carried the bulk of the load; in others it would seem to have been the first and second, and in still others the three original vertebrae continued their development to form such a sacrum as we find in *Dimetrodon*. In those forms with a single sacral vertebra the ilium has lost the posterior process and the

blade is relatively narrow. In the case of *Seymouria* we find the peculiar condition in which the first sacral rib has gained the ascendency, and the others have become reduced while the ilium still retains a very long posterior process (Figs. 25 and 27).

The second caudal rib is similar to the first, but is longer and stronger. It has a length of 40 mm. and is the longest of the series. I know of no other reptile in which the second caudal rib is so much longer than the first. From here back the ribs become shorter and weaker but retain the same general shape. The last caudal rib is about 10 mm. long.

Pectoral Girdle and Extremity

In the material at my disposal there are the elements of the pectoral girdle and extremity from a half dozen individuals. In most cases the elements have been disassociated. In one specimen (M. C. Z. No. 1643), the interclavicle, right clavicle and the right scapulo-coracoid unquestionably belong to the same individual. In this specimen it was possible to free the elements and clean all of their surfaces. Unfortunately, however, in no case is the humerus associated with the scapulo-coracoid or the radius and ulna with the humerus, although these elements are well represented in the material.

Scapula. The blade of the scapula is quadrangular in outline, about half as broad as long. It lacks the curvature characteristic of the contemporaneous reptiles and amphibians. The straightness of the blade of the scapula seems to be correlated with the very deep thoracic ribs against whose ends it surely must have abutted because it could not have overlapped them in the normal manner. Also the angle described by the clavicle would direct the scapula upward and outward as shown in Figure 18.

The upper end of the scapula is somewhat broader and heavier than that just above the glenoid. The upper edge and the upper one third of the anterior edge are unfinished bone indicating a rather large cartilaginous suprascapula. The remainder of the anterior edge nearly to the suture with the precoracoid is finished bone. This is shown in two specimens (M. C. Z. Nos. 1094 and 1650). As is usual for the scapula of the early terrestrial vertebrates, the anterior edge is thin and very nearly straight. There is a reëntrant angle, which was doubtless filled with cartilage in life, at the union of the anterior portions of the scapula and precoracoid.

The posterior edge of the scapula is much thicker and stronger than

the anterior. It curves upward and backward from the anterior end of the glenoid and meets the superior border at an angle of a little less than 90°. At about a third of the height of the scapula above the glenoid, the posterior border meets the supraglenoid buttress. The latter extends postero-ventrally to the posterior end of the glenoid. On the mesial side the supraglenoid buttress extends anteriorly to a point opposite the anterior end of the glenoid.

The lower third of the posterior border of the scapula and the supraglenoid buttress form the sides of the triangular supraglenoid fossa. The supraglenoid foramen is large and near the apex of the triangle. It is elliptical with the long axis parallel to the front leg of the triangle. It is 4.5 mm. long and 2.5 mm. wide. In several of the specimens the supraglenoid foramen was carefully cleaned with a weak solution of phosphoric acid. In all cases a foramen entered the substance of the bone from the dorsal side of the passage. Undoubtedly a rather large artery passed through this foramen and also, it is very probable, a nerve for the dorso-mesial muscles. Some specimens possess a nutrient foramen in the lower portion of the supraglenoid buttress on the medial side. However, it does not appear to be a constant feature.

If the position of the scapula was correctly determined the glenoid faces downward, backward and outward with the posterior end a little higher than the anterior. It is of the usual form for the primitive tetrapods. At either end is a rather large dorsal lip which received the greater portion of the upward thrust of the humerus. That at the anterior end is continuous with the posterior border of the scapula and that at the posterior is continuous with the supraglenoid buttress. The anterior lip was largely formed in cartilage which was continuous with that lining the glenoid, while the posterior lip was well ossified. The greater strength of the posterior lip fills a mechanical need in that it would receive the upward thrust of the humerus at a time when the fore leg on that side was making its maximum effort.

In view of the direction in which the glenoid faces and the projecting lips on its dorsal edge we are justified in the assumption that *Seymouria* was able to sustain the body above the ground when walking and that it spent considerable time on land. It is not to be inferred that it was as agile as the contemporary pelycosaurs or some of the cotylosaurs. It is also probable that some of the rhachitomous Amphibia were more agile on land. The robust limb bones indicate that it possessed sufficient brute strength to compensate for any awkwardness.

The subscapular fossa is bounded mesially by the supraglenoid buttress and the mesocoracoid arch and laterally by the anterior por-

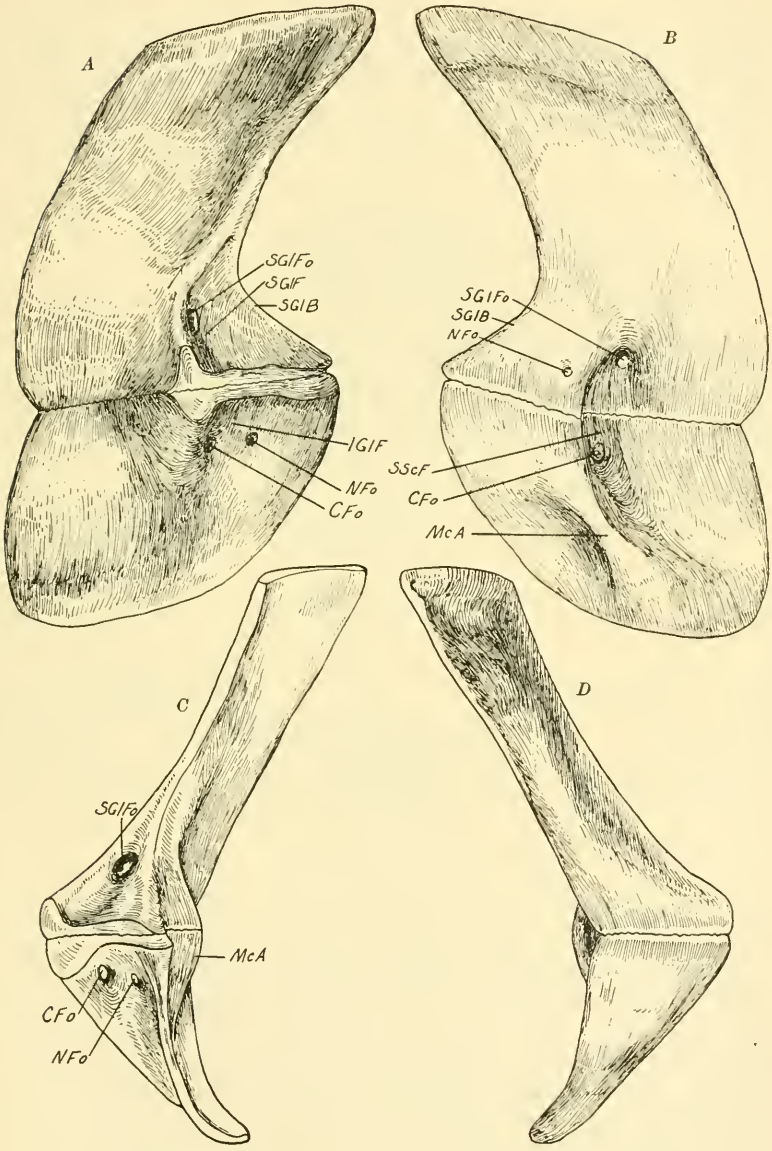

Fig. 17. Scapula-coracoid, A, lateral, B, medial, C, posterior and D, anterior aspect. x 1.

tion of the scapulo-coracoid. The suture between the scapula and coracoid passes through about the middle of the fossa, which is elliptical in outline with the long axis nearly vertical. The fossa is 25 mm. long and 14 mm. wide and lies opposite the anterior portion of the glenoid. Two foramina lead from the fossa to the outside, the

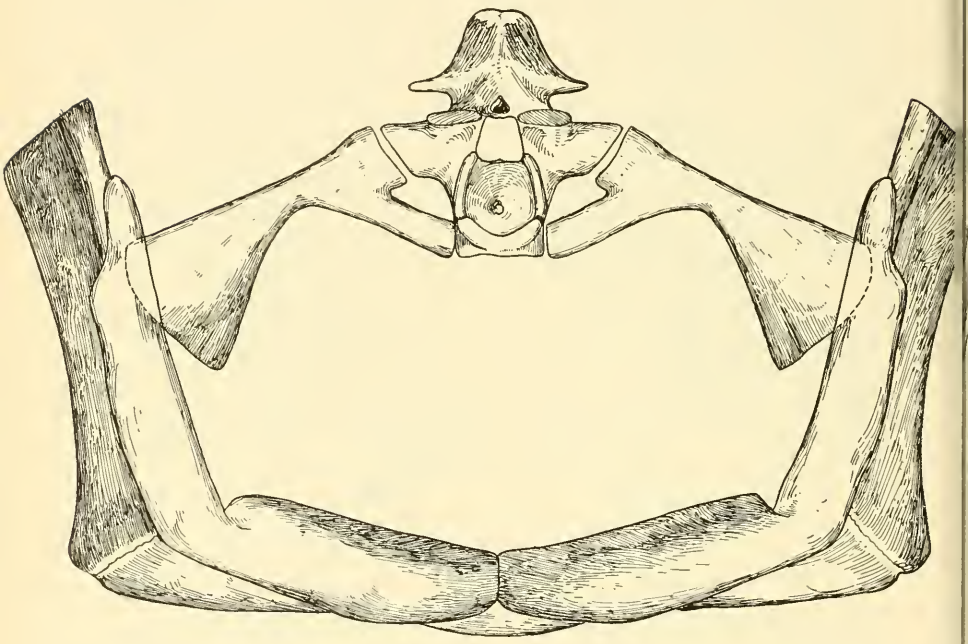

Fig. 18. Pectoral girdle and fourth vertebra and ribs, anterior aspect. x 1.

supraglenoid near the top and the precoracoid near the bottom. In none of the specimens have I found any trace of the glenoid foramen.

Precoracoid. The outline of the precoracoid is more or less that of an ellipse in which one quadrant has been truncated between the ends of the long and short axes. The coracoid portion of the glenoid lies along the line of truncation. The other edges were undoubtedly finished in cartilage. The mesacoracoid arch is high and thin and extends nearly to the anterior-inferior edge. The precoracoid foramen lies near the anterior border of the infraglenoid fossa about three mm. below the glenoid. This foramen is circular and somewhat smaller than the

supraglenoid. Two or three mm. posterior to the precoracoid foramen is a smaller nutrient foramen which is paired in one specimen. It seems probable that this foramen is the one which Watson (1918, p. 281) thought to be the glenoid foramen, but since the nature of the matrix on his specimen made it impossible to clean the scapula-coracoid on

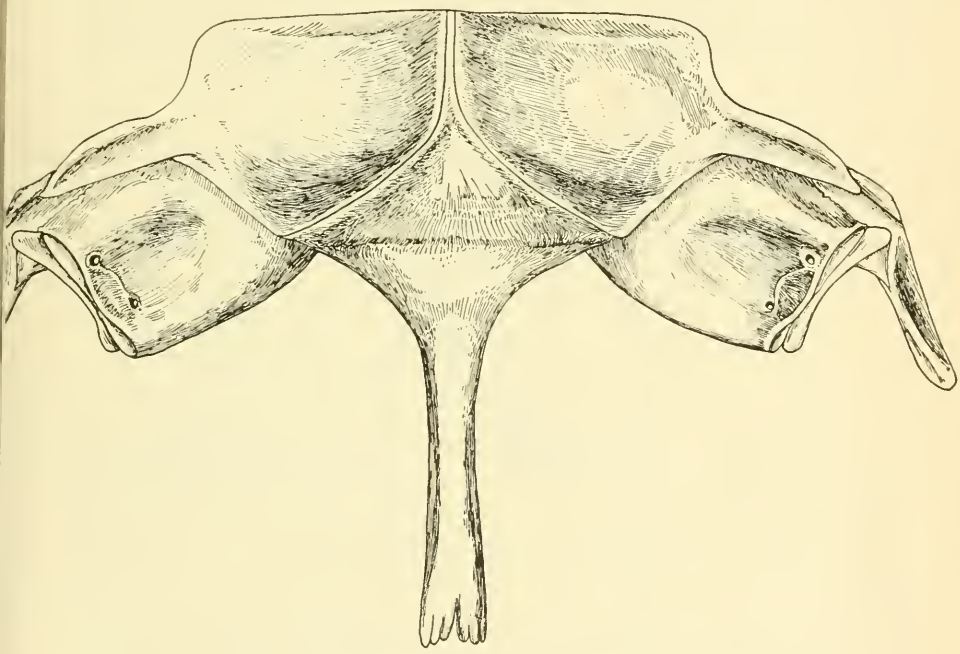

Fig. 19. Pectoral girdle, ventral view. x 1.

both sides the mistake is a natural one. Since in one specimen there is a distinct groove from the precoracoid foramen to the smaller nutrient foramen, it seems probable that an artery passed through the former along with the supracoracoid nerve.

The fusion of the scapula and precoracoid undoubtedly occurred late in life. In most cases the two elements are either separated or the suture is quite evident. In two specimens (M. C. Z. Nos. 1094 and 1643) the middle portion of the suture has been obliterated but the ends are still distinct.

Clavicle. The clavicle is the usual L-shaped bone with the two legs

of the L meeting in an angle of a little more than 90° (Fig. 20). The sternal portion is broad and spatulate with squarish angles. The median end is nearly straight and meets the anterior edge in an angle of a little less than 90° and the posterior in an angle of a little more than 90°. From the scapular process the anterior border passes forward for about 6 mm. and then turns inward to meet the mesial border. Along the anterior edge from the medial end to the scapular process is a broad, well defined muscle scar for the origin of the sternohyoideus

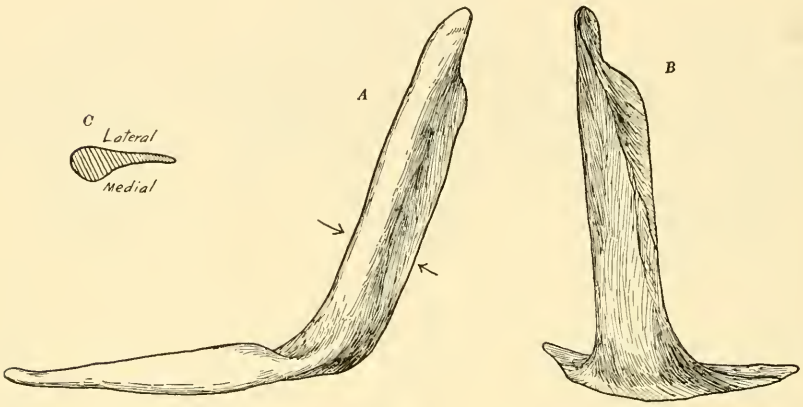

Fig. 20. Left clavicle, A, anterior and B, lateral aspect; C, section through the scapular process at point indicated by arrows. x 1.

and cleidomastoid muscles. The outer surface of the sternal portion is covered with a faint reticulate sculpture much less pronounced than that on the skull.

The scapular process is broader than in the contemporary reptiles and amphibians and covers the lower four fifths of the anterior edge of the scapula. The anterior third is heavy and robust and passes abruptly into the thinner portion which overlaps the front edge of the scapula (Fig. 20). The thin portion terminates rather abruptly about 5 mm. below the upper end of the scapular process.

Interclavicle. The interclavicle is a T-shaped bone similar to that of the contemporaneous cotylosaurs and pelycosaurs, but with much less curvature in the anterior portion. The breadth of the anterior portion is a little more than half of the total length. The areas upon which the clavicles rested are very rugose, as are the inner surfaces of

the sternal portion of the clavicles, indicating that a strong ligamentous connection existed between the clavicles and interclavicle. Between the clavicular areas and just in front of the posterior process is a triangular area, with the apex of the triangle directed forward, which is sculptured in the same manner as the clavicles.

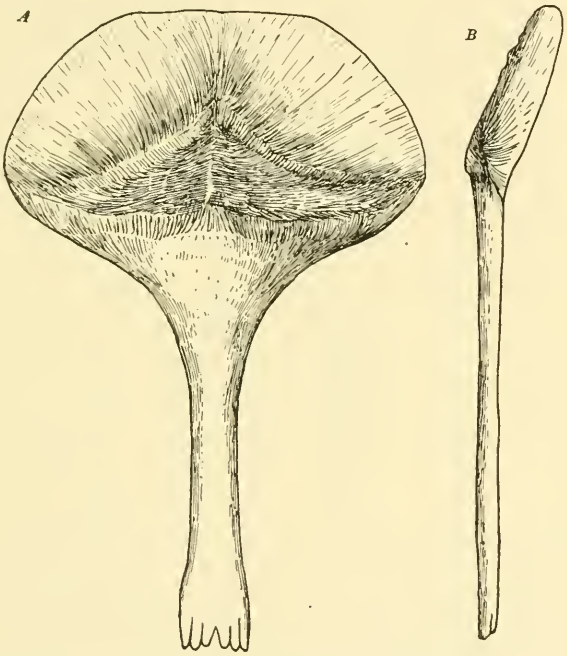

Fig. 21. Interclavicle, A, ventral, B, lateral view. x 1.

The posterior process makes up nearly two-thirds of the total length of the interclavicle and is free of any trace of sculpture. It is nearly uniform in width (6 mm.) throughout its length, except at the anterior end where it expands to meet the clavicular portion. The posterior end of M. C. Z. No. 1643 is divided by a rather deep median groove. The two halves are subdivided by smaller grooves. Probably the posterior end served as an attachment for episternal or abdominal ribs. However, I have not been able to identify positively abdominal ribs in the material at my disposal.

Cleithrum. One pectoral girdle (U. S. N. M. No. 9140) bears the

only complete cleithrum at my disposal. Two other specimens confirm its presence in *Seymouria*: M. C. Z. No. 1641, consisting of the dorsal half of the scapula with the corresponding portion of the cleithrum nearly in correct relation, and (W. M. No. 161) a nearly complete scapular blade with the upper portion of the clavicle and the middle portion of the cleithrum. The cleithrum is a slender, rather featureless bone, spatulate at the upper end. The spatulate portion is excavated on the median side to fit over the cartilaginous extension of the anterior edge of the scapula. Below this it is a slender rod of

Fig. 22. Right cleithrum, A, lateral, B, anterior aspect. x 1.

bone about 3 mm. wide and 2 mm. thick. The lower two thirds is hidden beneath the scapular process of the clavicle. The cleithrum extends nearly the entire length of the anterior edge of the scapula.

Humerus. (Fig. 23). The humerus has the "tetrahedral" shape characteristic of the primitive tetrapods. For the most part, muscle scars are poorly developed and the condyles and processes are finished in cartilage. The relative amount of cartilage was probably a little more than in a very old *Eryops* but was not sufficient to conceal the major details of form.

The general form seems to be intermediate between *Eryops* and *Diadectes,* resembling the former in the major features and the latter in several details. The relative amount of "twisting" seems to be a little less than that in either form, i.e., the plane of the distal end of the humerus is beginning to approach the same plane as that of the proximal end. This is a feature of the primitive tetrapods which have a

tendency "to get their legs under them," as well as certain secondary aquatic forms such as *Cricotus* (Romer, 1922, p. 556). It seems probable that this similarity of form in the humeri of animals living in such different media may be correlated with the similarity of movements described by the limbs. That is, if *Cricotus* was a "bottom walker," as is *Chelydra serpentina* Linné, the limbs, aided by the buoyance of the water, would assume nearly the same position and describe the same movements as those of a terrestrial reptile which walked with the body well off of the ground. If *Chelydra serpentina* can be used as a safe criterion, the "bottom walkers" often have quite as good a mode of progression on land as the habitually terrestrial forms belonging to the same order. Judging by the direction in which the glenoid faces and the shape and position of the glenoid articulation on the head of the humerus, *Seymouria* walked with the humerus inclined downward at an angle of about 45°. During the stride the humerus moved from a position at right angles to the body at the beginning to a position nearly parallel to the body at the end. Also judging by the articular surfaces at the distal end of the humerus, the radius and ulna at the beginning of the stride were inclined forward at an angle of about 45°. At the end of the stride the elbow was nearly, but not quite, straight. It is easier to believe that *Seymouria* was able to assume the "stand up" position aided by the buoyant effect of the water. However the robustness of the bones indicate that it was undoubtedly quite capable of handling its weight on land.

The glenoid articulation of the humerus extends nearly the whole width of the flat head. The anterior portion of the articulation faces mesially and but very slightly dorsally. It passes smoothly into the posterior portion which faces mesially and ventrally. The principal difference between the humeri of *Seymouria* and the contemporaneous forms is the lack of a strong upward tilt in the anterior portion of the glenoid articulation. Consequently any angle of the humerus with the body of less than 45° would have dislocated the former. On the anterior side of the humerus the L-shaped delto-pectoral crest is large and strong. It begins about 8 mm. distal to the head and extends nearly to the midlength of the humerus. At this point it turns abruptly dorsalwards to form the short leg of the L. In one specimen there is a narrow band of finished bone between the insertions of the deltoideus and the pectoralis muscles. About 3 mm. distal to the delto-pectoral crest is the prominent supinator process. It is oval in cross section, slightly flattened on the ventral side. It projects about 5 mm. beyond the antero-dorsal edge of the humerus, the same distance as the delto-

pectoral crest. About 8 mm. distal to the supinator process on the postero-dorsal portion of the distal end of the humerus is the strong ectepicondyle. Its most important feature is that it projects posteriorly and laterally rather than posteriorly and dorsally as in *Eryops* and *Diadectes*. Its postero-dorsal border passes smoothly into the medio-lateral line of the humerus. On the anterior side of the ectepicondyle lies the hemispherical radial epicondyle. Its articular surface extends

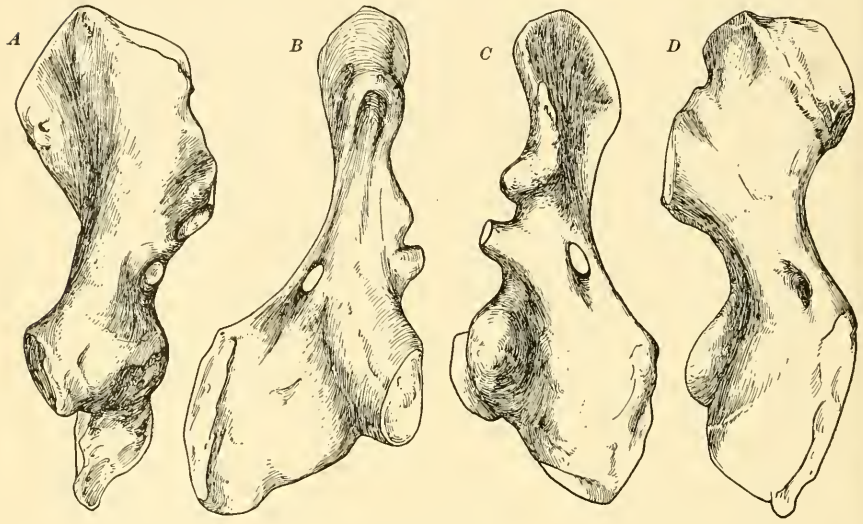

Fig. 23. Right humerus, A, dorsal, B, posterior, C, ventral, D, anterior aspect. x 1.

around the end of the humerus so that the medio-lateral dimension is about one and one-third times the dorso-ventral. This would allow the radius to move through an arc of about 60°. That is, the angle which the radius makes with the humerus at the beginning of the stride would be about 90° and at the finish would be about 150°.

The ulnar epicondyle does not differ essentially from that of the contemporaneous reptiles and terrestrial amphibians. Anteriorly it is continuous with the radial epicondyle, but the two are separated posteriorly. Ventral to the ulnar epicondyle is the broad entepicondyle which, in general shape, is intermediate between *Eryops* and *Diadectes*. It cannot be said to resemble one any more than the other. It is not

as heavy and robust as in *Eryops* but is more so than *Diadectes*. Just distal to the midlength of the humerus is the elliptical entepicondylar foramen. It is relatively somewhat smaller than in *Diadectes*.

For the most part muscle scars are poorly developed. However on the dorsal side of the head of the humerus, near the posterior border, are two rather prominent tubercles for the insertions of the latissimus dorsi and the subcoraco-scapularis respectively. In the proximity of these insertions to the glenoid articulation, *Seymouria* resembles *Cricotus*, *Diadectes*, and many of the pelycosaurs and differs radically from *Eryops* in which the insertion of the latissimus dorsi is a third of the length of the humerus from the glenoid articulation.

Radius. In the material at my disposal is an associated radius and ulna (M. C. Z. No. 1658). The radius (Fig. 24B) is short subcylindrical and moderately robust. In a specimen of *Conodectes Favosus* Cope (U. S. N. M. No. 9140) the length of the radius is 0.65 of the length of the humerus. In the disassociated material pertaining to *Seymouria* in the Museum of Comparative Zoölogy the lengths of the radii average about 0.6 that of the humeri.

The proximal articular face of the radius is concave to fit the hemispherical radial epicondyle. It is triangular in outline with the apex directed forward. From the proximal end the radius rapidly assumes a cylindrical form and the diameter decreases till it reaches its minimum a little distal to the midlength. At this point the diameter of the shank is about half the width of the proximal end. From this point distally the radius expands in such a manner that the distal end is rectangular in outline. The antero-posterior dimension is about three fourths that of the mesio-lateral, thus presenting a large articular surface for the carpal elements.

Ulna. The ulna, (Fig. 24A) like the radius, is short and robust. In general it resembles that of *Eryops* more than *Diadectes*. Both the distal and proximal ends are expanded laterally and lie in the same plane as in the contemporaneous reptiles. Also both ends were finished in cartilage. Consequently it is difficult to determine the development of the olecranon. Probably it was as well developed as in *Eryops* or *Diadectes* but remained cartilaginous. In none of the ulnae is there preserved the facet for articulation with the proximal end of the humerus. If present it must have been included in the cartilage cap of the proximal end. The shank is about half as wide as the proximal end and is oval rather than round in cross section. The expanded distal end is slightly curved so that the median portion is extended a little farther than the medial and lateral edges. The medio-lateral

dimension of the distal end is twice that of the antero-posterior. The total width of the distal ends of the radius and ulna is less than that of the tibia and fibula; the antero-posterior dimension is much greater. Consequently the carpus was, in all probability, as strong as the tarsus.

Manus. The foot material at my disposal has been largely disassociated. In one case some of the tarsal elements are associated with a tibia (M. C. Z. No. 1099), but there are no associated metatarsals. In

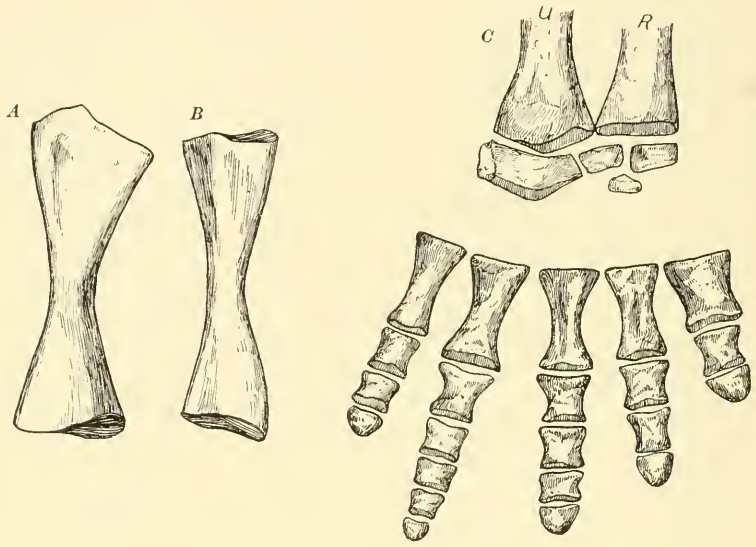

Fig. 24. Right fore limb, anterior aspect, A, ulna, B, radius, C, manus. x 1.

another case a series of metapodials and four mesapodial elements are attached by matrix to a humerus (M. C. Z. No. 1662) . In the other foot material there are two sizes of metapodials. Normally the longer would be the metatarsals and the shorter the metacarpals. Those attached to the humerus belong to the shorter series. Also the associated mesapodial elements are quite different from those attached to the above mentioned tibia. The sum of the widths of the three largest mesapodials equals the sum of the widths of distal ends of an associated radius and ulna (M. C. Z. No. 1658), which in turn is about one fifth less than that of an associated tibia and fibula. Consequently it seems relatively certain that these elements belong to the *manus* and not to the *pes*. Unfortunately many of the phalanges are missing.

The parts preserved are: radiale, intermedium, ulnare, a small centrale, the first four metacarpals, and the first phalanx of the first, third and fourth digits. The elements have been slightly disarranged but not sufficiently to defy interpretation. In addition there are several isolated carpal elements (M. C. Z. No. 1663) of the same general form but slightly different proportions, which indicate that the carpus embraced considerable cartilage and continued to ossify after the animal became fully mature. The elements increase in thickness (i. e. proximo-distally) but very little in width.

The radiale is a small rectangular bone twice as broad as thick and a little deeper than broad. As stated above the elements seem to thicken with age. In an isolated radiale the width is only one and one-half times the thickness. All of the faces are finished in cartilage except the anterior. It is slightly concave.

The intermedium is similar in shape to the radiale but a little wider. All faces were finished in cartilage except the anterior and posterior.

The ulnare is the largest bone in the carpus. Its width is nearly equal to that of the radiale and intermedium. Posteriorly it is somewhat thicker than anteriorly, a feature which *Seymouria* shares with *Diasparactus*. Its anterior face is rectangular in outline, slightly curved forward medio-laterally and straight proximo-distally. The posterior face is triangular in outline with the base of the triangle proximal and the apex distal. The lateral face is finished bone in one specimen (M. C. Z. No. 1663) which probably belonged to a very old individual. The other specimens represent all stages from a surface finished in cartilage (M. C. Z. No. 1662) to that of the one just mentioned. The proximal, distal and medial faces were finished in cartilage. It is impossible, with the preservation of the available material, to be certain of the presence or absence of the pisiform.

The centrale is a small rectangular bone about half as large as the intermedium. All of its faces were finished in cartilage except the anterior and posterior.

The metacarpal of the first digit is shorter and more robust than those of the other digits. Both the proximal and distal ends were finished in cartilage. It, as well as the other digits, is considerably flattened and not rounded as in more advanced reptiles. It shares this character with the diadectids and many of the Rhachitomi. The width of the proximal end of the first metacarpal is equal to its length and the thickness is equal to one half of the width. The width of the distal end is somewhat less than the proximal end. The distal end makes a small angle with the axis of the bone so that the lateral side of the element is

somewhat longer than the medial. Also, the articular surface slopes backward somewhat from the dorsal surface.

The first phalanx is similar in shape to the first metacarpal but only a little over one half as long. The oblique condition of the distal end is accentuated over that of the metacarpal.

The remaining metacarpals are of nearly the same shape and proportions. As would be expected the second is the shortest and the fourth the longest. They are more or less hourglass shaped with expanded ends and rather narrow shank. The two ends are of equal width but the proximal end is about 1½ times as thick as the distal. The phalanges preserved are very similar to the first except that the distal end is not on a bias with the axis of the bone. The articular surface slopes downward and backward from the dorsal surface. This feature is present in all of the phalanges which I have been able to examine. Undoubtedly the toes were flexed as in *Diasparactus* (Case and Williston, 1913) and *Diadectes* (Romer, 1931). Only one specimen shows the terminal phalanx, an isolated third digit, which may belong to either the manus or pes. The terminal phalanx is a "hoof" as in *Diadectes* and *Diasparactus*.

Pelvic Girdle and Extremity

The elements of the pelvic girdle and extremity are abundantly represented in the material at my disposal, but associated elements are rather scarce. They consist of: a pubis, ischium, and lower portion of the ilium (M. C. Z. No. 1661); two nearly complete ilia with two anterior caudal vertebrae (M. C. Z. No. 1644); a femur, tibia, and part of tarsus (M. C. Z. No. 1099); a tibia and fibula (M. C. Z. No. 1093). As was stated earlier in the paper the material represents the remains of nine individuals. This figure was arrived at by counting the proximal ends of the femora, which gave a total of eighteen. It is possible that more individuals are represented than I have accounted for.

Ilium. In general shape the ilium (Fig. 25) is very similar to that of *Cricotus* in that the posterior process is well developed and is supported by a strong ventral "rib." Also the anterior edge of the iliac blade passes upward and forward from the supraacetabular neck of the ilium. From about the middle of its height nearly to the top, the anterior edge curls inward around the anterior edge of the first sacral rib. From the antero-dorsal angle the dorsal edge of the iliac blade passes upward and backward to a point above the dorsal lip of the acetabulum. From here it passes downward and backward nearly to

the end of the posterior process. About midway of this distance is a small V-shaped emargination, probably homologous with the larger

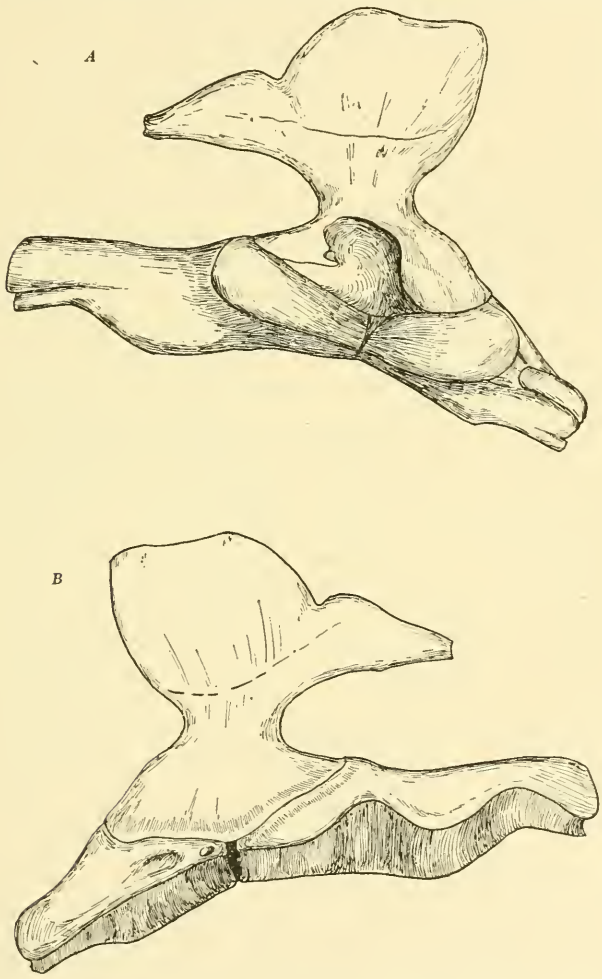

Fig. 25. Right half of pelvis, A, lateral, B, medial aspect. The dotted line in B indicates the lower limit of the first sacral rib. x 1.

one in *Cricotus*. The dorsal edge of the iliac blade is crenulated and the inner surface is corrugated, indicating a rather strong ligamentous

attachment with the first sacral rib. On the outer surface of the ilium the transverse line (Fig. 25A) for the attachment of the dorsal axial muscles, is well defined in only one specimen. It is relatively a little higher than in *Cricotus* and *Eryops* but is much lower than in *Diadectes*.

The posterior process is supported by a strong ventral "rib" which arises just above the dorsal lip of the acetabulum and curves upward and backward. It extends posteriorly nearly to the posterior end of the first caudal vertebra. The length is comparable to that in *Cricotus* and other Embolomeri. The length of the posterior process probably was not augmented much by the cartilaginous termination. At its posterior end it received the attachment of the upper end of the ilio-ischial ligament upon which the flexor tibialis muscles had their origin. These muscles, which are important in drawing the leg backward, would have as great a mechanical advantage in *Seymouria* as in *Dimetrodon*. The principal handicap to the terrestrial progression of *Seymouria* lies in the very poor development of the ilio-femoralis (gluteal) muscles. This handicap was probably offset somewhat by the great development of the dorsal lip of the acetabulum and great development of pubo-ischio-femoralis externus muscles. "Bottom walking," as was suggested in the discussion of the humerus, would make the handicap of the very weak ilio-femoralis nearly negligible.

The area just above the dorsal lip of the acetabulum is the narrowest part of the ilium. Below this area it expands rather rapidly to meet the pubis and ischium and form the iliac portion of the acetabulum. The articular surface for the head of the femur is a little posterior to the midlength of the lower portion of the ilium (Fig. 25). The upper portion of the articular surface is produced outward in a rather prominent shelf, the dorsal lip of the acetabulum, which projects outward for a distance of about 6 mm. over the rest of the acetabulum (Figs. 26 and 27). With the exception of a small area at the lateral edge of the dorsal lip of the acetabulum, the blade of the ilium rests directly over the projecting shelf. Thus the upward thrust of the head of the femur would be transmitted efficiently through the blade of the ilium and through the sacral rib to the vertebral column. The union of the blade of the ilium with the first sacral rib and of the rib with the vertebra were probably firm enough so that there was very little loss of energy by movements of these parts. The acetabulum presents a triradiate articular surface very similar to that of the contemporaneous tetrapods. Also the iliac portion occupies only about one third of the lateral surface of the lower portion of the ilium. Anterior and posterior to this the bone is quite smooth. On the posterior side of the articular

surface, a little below the dorsal lip of the acetabulum, lies the rather shallow acetabular notch. In one specimen the lower portion continues as a narrow groove nearly a third of the way across the articular surface (Fig. 25A). The specimens which do not show this seem to be somewhat younger. Anterior and posterior to the articular surface

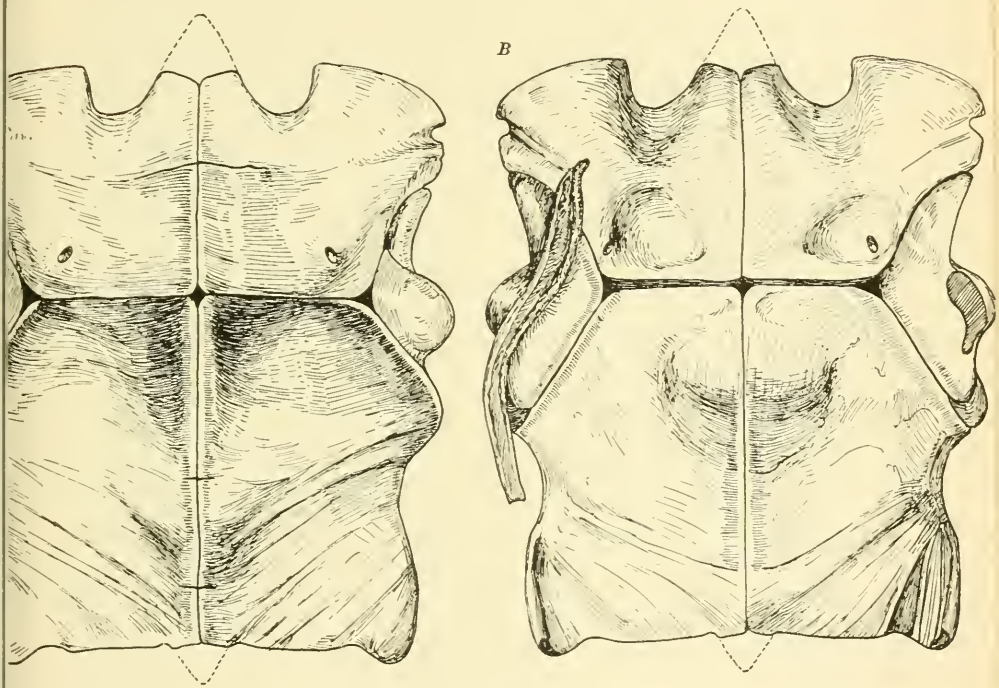

Fig. 26. Restoration of pelvis, A, ventral, B, dorsal aspect. x 1.

the bone curves outward so that the head of the femur is enclosed in a deep hollow.

On the medial side of the lower portion of the ilium is a low obtuse ridge running dorsally from the point of union of the ilium, ischium, and pubis. It fades out at about the level of the dorsal lip of the acetabulum. This ridge is probably homologous with the anterior ridge of *Cricotus* and *Eryops* and the corresponding ridge in *Dimetrodon*. It seems to mark the posterior portion of the origin of the pubo-

ischio-femoralis internus. In this feature *Seymouria* seems to be more advanced than many of the pelycosaurs.

On the mesial side of the ilium along the suture with the ischium are numerous rather closely set striations perpendicular to the line of the suture. There are similar striations on the corresponding part of the ischium and also between the posterior halves of the ischia. Undoubtedly there was a strong ligamentous union across this suture. If the opinion stated earlier that *Seymouria* laid large yolked eggs be true, this connection would allow a spreading of the bones of the pelvis during deposition of the eggs without permanent displacement.

Pubis. The pubis is a flat bony plate whose outline varies from quadrangular in the mature individuals to nearly circular in the young. It was finished in cartilage on all its edges except a small area on the anterior side between the pubic tubercle and a point near the midline. This area is rather deeply emarginate and the bone is drawn out to a thin sharp edge. Between this emargination and the midline the pubis is produced forward a short distance and bears evidence of a triangular epipubic cartilage. The medial edge of the pubis is nearly straight in the mature individuals. Opposite the anterior edge of the acetabular swelling the pubis increases abruptly in thickness. The portion posterior to this point is nearly twice as thick as that anterior. This point probably marks the anterior limit of the origin of the pubo-ischio-femoralis externus. The posterior edge is nearly straight and has a thickness nearly equal to that of the posterior portion of the medial edge. The acetabular portion cuts across the postero-lateral angle of the pubis and is much thicker and heavier than the rest of the bone. The acetabular face lies in a nearly vertical plane. It is elliptical in outline with the short axis equal to two thirds that of the long axis. In one specimen which appears to be a very old individual there is a small area of finished bone on the lateral edge between the acetabulum and the pubic tubercle. The latter is very broad, extending from just in front of the acetabulum to the midpoint of the anterior side. It is directed forward and outward. The obliquus abdominus externus, rectus abdominus, ambiens, pubo-tibialis, and possibly in part the pubo-ischio-femoralis internus have their origin on the pubic tubercle. Of these the last three are important muscles in walking and in holding the body well off the ground, especially the pubo-ischio-femoralis internus. The leverage obtained as it passed over the pubic process of the ilium would be very instrumental in preventing the body from slumping on one side when that leg was lifted from the ground. .

The obturator foramen is elliptical in outline. It is 4 mm. long and 1.5 mm. wide. It is located in the postero-lateral angle of the pubis just anterior to the mesial ridge of the ilium. Only in the mature individuals is it completely enclosed by bone.

Ischium. The ischium is a large bony plate roughly rectangular in

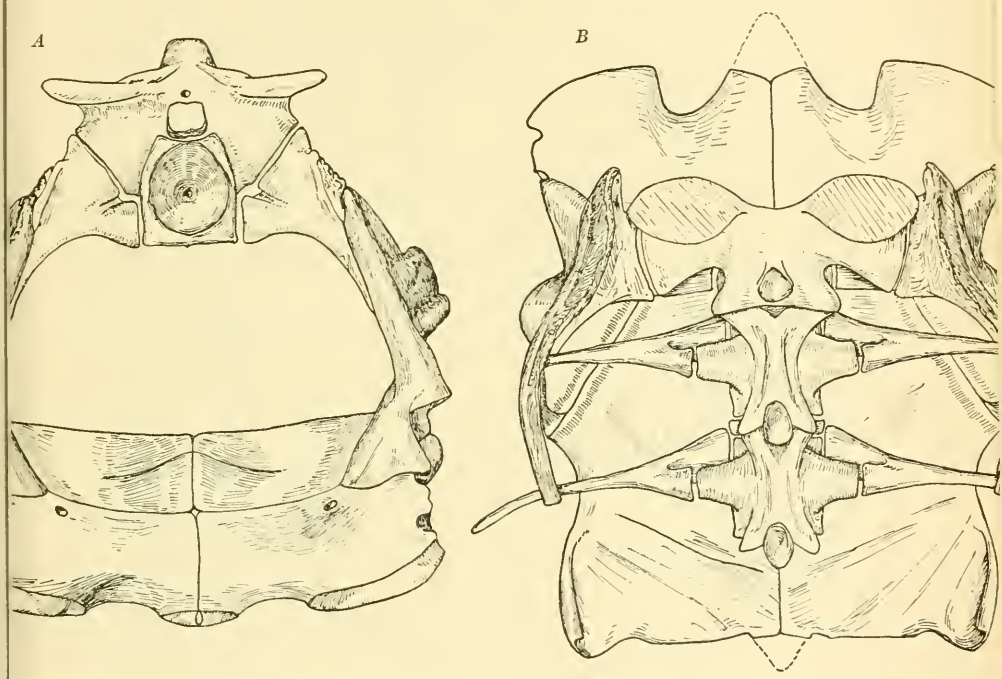

Fig. 27. Restoration of pelvis and sacrum, A, anterior, B, dorsal aspect. x 1.

outline, a little less than twice as long as wide. The acetabular swelling on the antero-lateral angle is oval in outline somewhat thicker posteriorly than anteriorly. Anteriorly it is reduced rather quickly to the thickness of the anterior border of the ischium. The meeting point of the pubes and ischia could not have embraced a cartilage plug of any size since all of the bones involved have relatively sharp angles. On the medial border opposite the posterior end of the acetabular swelling is a thickened area which projects upward into the pelvic cavity. This

thickened area slopes away on three sides and with its fellow makes a low conical boss which is surrounded by bone of the same thickness as that of the anterior edge. Behind this boss is a U-shaped valley followed by a low rounded ridge which is formed by a curving of the bone (Fig. 25). The intensity of the curving of the ischium along the midline appear to be correlated with age, being greater in the older individuals than in the young. Posterior to the thickened area the ischium bears evidence of being ligamentously united to its fellow, a feature in common with the more advanced Palaeozoic reptiles. The significance of this was discussed in connection with the ilium. The cartilaginous termination of the medial border is continued onto the posterior border for a distance of about 4 mm. It seems probable that there was a short postischial cartilage. The remainder of the posterior border and the entire lateral border is finished bone. The ischial tubercle is a broad thin process projecting posteriorly a little beyond the rest of the bone. The lateral edge is curved upward to give the process a trough-like appearance. The lateral edge of the bone is broadly emarginate between the ischial tubercle and the acetabulum.

Femur. (Fig. 28.) The femur is short and robust. The general contours resemble *Eryops* a little more than *Diadectes*, but it is not as slender as the former. The head is broad and flat as in *Eryops*. The breadth is a little more than twice the greatest thickness and is equal to a little less than one half of the length of the femur. On the dorsal surface of the head near the posterior border is a well defined muscle scar for the insertion of the pubo-ischio-femoralis internus. This is the only muscle scar on the head. On the dorsal side the head passes smoothly into the very short shank which is only one third as wide as the head. Distally the shank expands smoothly into the two condyles which are separated by a broad U-shaped trough. The articular surface of the distal end of the femur describes an M-shaped curve characteristic of the early tetrapods whose long bones were terminated in cartilage. The adductor ridge is very prominent with the bifurcation a little distal to the midlength of the femur. This is probably the most characteristic feature of the femur of *Seymouria*. As far as I know no other vertebrate has the bifurcation of the adductor ridge placed so far distally. The fourth trochanter is located at the bifurcation of the ridge rather than on the posterior branch as in *Eryops* or the anterior as in *Diadectes*. The posterior ridge descends rather steeply to the level of the head but not as abruptly as *Eryops*. The anterior ridge continues to the head.

Watson (1918, p. 291) compares a femur from the lower Mississip-

pian of Scotland, to which he gave the name *Papposaurus traquairi*, with *Seymouria*. A close comparison of his figures (1914) with the femur of a rather old *Cricotus* shows the two to be almost identical. A further comparison of the above mentioned femur of *Cricotus* with that of *Dimetrodon* shows that it would not be difficult to derive the latter from the former without an intermediate stage such as *Eryops* or *Seymouria*. The evidence that *Papposaurus* is a reptile is not conclusive; however it is entirely possible that it might be.

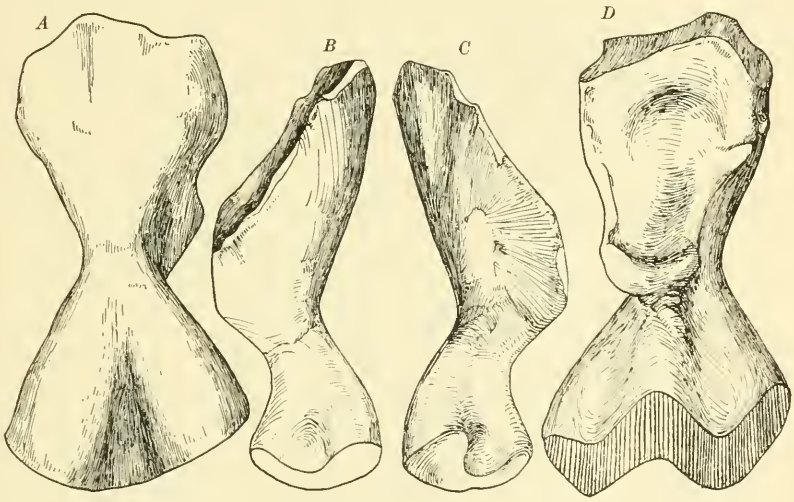

Fig. 28. Left femur, A, dorsal, B, posterior, C, anterior, D, ventral aspect. x 1.

Tibia and *Fibula*. The tibia (Fig. 29B and C) is short and robust and undoubtedly carried the bulk of the load. Its length is equal to three fourths that of the femur. The proximal end is roughly triangular in outline with the anterior side the shortest. The medial side is curved inward somewhat. The lateral edge of the triangle is broadly emarginate near the anterior edge. On the antero-lateral angle is a prominent ridge for the insertion of the triceps tendon. This ridge diminishes distally till it disappears at about the midlength of the tibia. The posterior angle of the head continues downward on the shaft as a thin sharp ridge on the postero-lateral surface of the tibia. It terminates about a third of the length of the tibia from the distal end. The shank

is very short and of relatively small diameter. It gives the appearance of being a constricted area between the two expanded ends. The distal end is expanded medio-laterally but its antero-posterior dimension is very little greater than the diameter of the shank. The expanded distal end is a little more than twice as long as broad.

The fibula resembles the ulna very closely in general shape. However the ulna is heavier and stronger and the distal end is much thicker. The fibula is a relatively slender flattened bone. The expanded distal end is nearly three times as wide as the shank. The

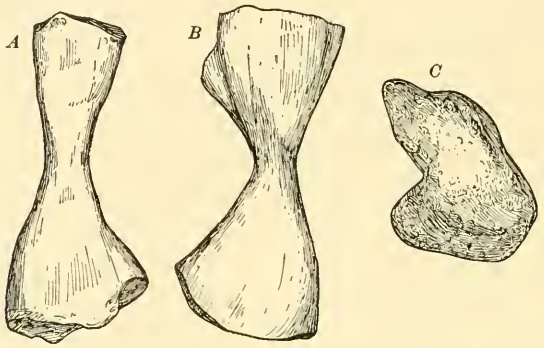

Fig. 29. Anterior aspect of right, A, fibula and B, tibia. C, proximal end of tibia. x 1.

proximal end is nearly twice as wide as the shank. The lateral side is nearly straight but the medial side curves outward broadly between the two ends.

Pes. The tibiale (Fig. 30) is nearly rectangular in outline with the long dimension placed parallel to the axis of the foot. The anterior, posterior, and the lower portion of the lateral surface are finished bone and the other surfaces were finished in cartilage. At the dorso-mesial angle the bone is expanded both anteriorly and posteriorly so that the tibia would articulate across this angle. This condition of the tibiale foreshadows that in the pelycosaurs.

The intermedium is a flat quadrangular bone, a little thinner in the middle than on its edges. All of the working surfaces were finished in cartilage. I do not find the well formed notches on the dorsal and ventral edges which Watson (1918) describes, but this may be due to the difference in age of the two specimens.

The fibulare is quadrangular in outline with all of its working surfaces finished in cartilage. It is somewhat smaller than the intermedium but does not differ greatly in other respects.

The mesial centrale is represented by three specimens. It is a flat

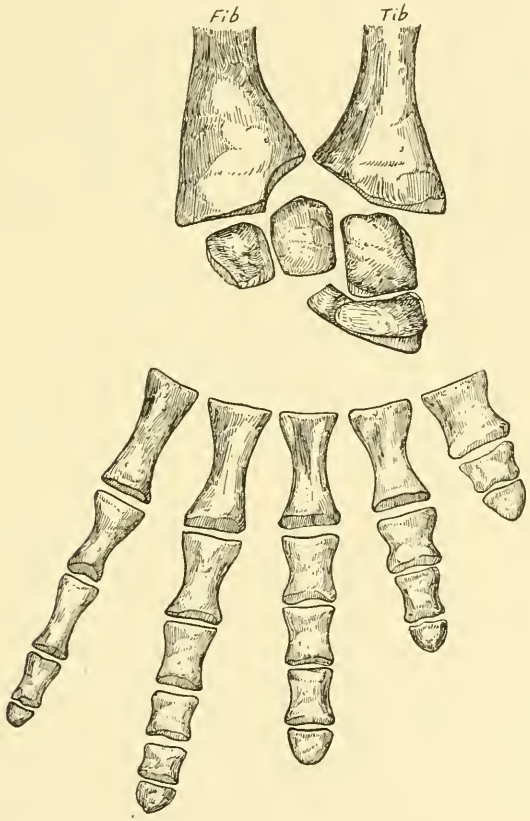

Fig. 30. Restoration of right pes. x 1.

bone, triangular in outline from the proximal aspect with the apex of the triangle directed laterally. On the apex is a small boss which would fit between the tibiale and intermedium. All except the anterior and posterior surfaces are finished in cartilage.

As stated earlier there are no elements which can be definitely

identified as metatarsals. However, there are a number of the longer metapodials which are very probably metatarsals. With these are several phalangeal elements, some in very nearly their proper relation.

The metatarsals and phalanges are rather broad and flat, as are those of the manus. The metatarsals are a little longer and more robust than the metacarpals. The first phalanx seems to be proportionately longer and stronger than in the manus.

The more distal phalanges seem to be about the same as those in the manus. The distal ends of the phalanges indicate that there was a flexure of the toes much as in *Diadectes* and *Diasparactus*. There are no terminal phalanges associated with the material of the pes. However they were very probably the same as those of the hand.

Natural History

Utilizing the inferred mechanics of the skeleton based upon the articular surfaces of the various elements as set forth in the preceding paragraphs, I shall attempt a restoration of the ethology of this primitive tetrapod. I shall draw upon the habits of Recent reptiles only to illustrate certain points, and do not infer that there could possibly be any direct correlation between the habits of any living form and those of *Seymouria*.

One of the most striking features of the skull is its architectural frailty. The outstanding weak spot is the very large otic notch. Although the notch is reinforced by a rim of heavier bone, the skull does not approach the strength of a form like *Captorhinus*. Also by its great forward extent the otic notch restricts the mass of the adductor mandibuli muscles and consequently reduces the force of the bite.

The principal lines of reinforcement of the skull are: a rim of heavier bone around the lower edge of the skull which supports the teeth; a loop from side to side just in front of the orbits, and a thickening of the posterior edge of the skull table which is continuous with the thickened rim of the otic notch. The bones of the skull are of average thickness for an animal of this size. In view of the skull structure *Seymouria* would be at a disadvantage in a struggle with the contemporary reptiles of nearly equal size.

The teeth are of the simple conical type without any pronounced specializations. The anterior maxillary teeth are larger than the others but on the whole they are grasping rather than tearing teeth. The ratio of the length of the tooth row to the jaw length is approximately

2:3. This would place the jaw muscles at a disadvantage of 3:1. In the dimetrodonts and sphenacodonts, the length of the tooth row to the jaw length is a little over 1:2. In the ophiacodonts it is about the same as in *Seymouria*. It is evident then, that the jaw equipment of *Seymouria* is not suitable for overpowering and tearing apart large active prey.

There is no indication of a prodigious development of jaw muscles such as would be expected if *Seymouria* was an active predator. The few muscle scars present indicate that the jaw muscles were somewhat advanced over the condition in *Cricotus* and *Eryops*. The pterygoideus looped around to insert on the outside of the angular as it does in the higher cotylosaurs and pelycosaurs. The pterygoideus anterior seems to have had its origin quite far anterior. Its origin is probably on the posterior end of the prevomer. The muscle scar on this bone is much too large and prominent for the anterior oblique eye muscles only. The rugosity of the flange of the pterygoid bears evidence that the posterior pterygoideus was large and strong. Judging by the size and rugosity of the posterior coronoid the adductor mandibuli muscles were comparable to the others in size and strength. The muscles represent a distinct advance over the contemporary Amphibia but are not so well developed as those of the higher cotylosaurs and pelycosaurs.

No coprolites are known which unquestionably belong to *Seymouria*, consequently the nature of its food is entirely conjectural. From the nature of its teeth it is probable that plants did not form a major portion of its diet. However many of the aquatic turtles, which presumably subsist mainly on frogs and fish, consume considerable quantities of duckweed and filamentous algae. In all probability *Seymouria* exercised very little selectivity in regard to its diet and it took as food anything it could catch and swallow. At any one time it probably subsisted on those forms which were most abundant. The following classes of invertebrates were probably available as food: Annelida, Crustacea, Myriapoda, Insecta (11 orders), Merostomata, Embolobranchiata, Gastropoda (pulmonate and probably freshwater), Pelecypoda, Ostracoda, and Branchiopoda. Many of these invertebrates are of such a nature that they are not readily preserved as fossils except under unusual circumstances, such as the Burgess Shale of the Cambrian. Consequently their absence as fossils from the Texas Redbeds is no indication that they were not present at the time the beds were being deposited. Their presence is quite probable since most of the groups are known from the Cambrian.

The vertebrates which might have served as food are little better known. The known fish, small enough to be ingested easily, are limited to two forms (*Eurylepidotes socialis* Case and *Platysomus palmaris* Cope). Both of these forms are from the Wichita division of the Red Beds. Their descendents probably were present in Clear Fork times. It is reasonable to assume that there were other forms as yet undiscovered. In the light of the habits of Recent reptiles and amphibians the young of all species probably contributed to the sustenance of the adults.

The broad zygapophyses are one of the most characteristic features of *Seymouria*. I am inclined to believe that this is an adaptive feature rather than a primitive character. The breadth of the zygapophyses would permit the vertebral column to undulate laterally but would prevent any torsion. The absence of torsion in the column would compensate for the weak ilio-femoralis (gluteal) muscles which prevent the body from slumping on one side when that foot is lifted off of the ground. Thus the broad zygapophyses would give *Seymouria* an essentially rigid body which could be supported very easily, without a great development of the gluteal muscles, on a three- or even two-point suspension. In view of the above statements the nature of the vertebrae seem to be an adaptation to facilitate terrestrial progression rather than a primitive character.

The greatly expanded subscapular ribs are a very perplexing feature of *Seymouria*. Normally these ribs are heavier and stronger than the others but are not usually developed to such a degree. It seems very probable that they supported extraordinarily well developed serratus muscles. Why these muscles should have reached the state of development that the ribs indicate is not obvious. The terminal phalanges are very small and could not have supported a digging claw suitable for burrowing or tearing decaying vegetation apart in search of food. The skull, and especially the snout, is not strong enough for rooting or to serve as a wedge for the animal to force its way into tangled or decaying vegetation far enough to bring the powerful shoulders into play. About the only other possibility is that this condition is an exaggerated feature correlated with the prosthenic mode of progression characteristic of the early tetrapods.

The method of filling and emptying the lungs in *Seymouria* can only be expressed as a probability. It seems reasonable to assume that lingual breathing was the first method employed by any vertebrate. When or in what forms the ribs began to be employed to give a more rapid exchange of gases is not apparent in our present state of knowl-

edge. Olson's (1936) analysis of the axial musculature of *Diadectes* indicates that it was capable of costal breathing. He indicated that the axial musculature of *Seymouria* was in all probability the same. The material in the M. C. Z. supports this view. Certainly those Recent reptiles with movable ribs employ costal breathing much of the time. Along the anterior edge of the clavicle is a broad well defined muscle scar for the origins of the cleidomastoid and the sternohyoideus. What portion of the scar is devoted to each muscle is not apparent but doubtless each was well developed. In view of the above data it seems reasonable to assume that *Seymouria* filled and emptied its lungs by utilizing both methods.

The very broad sacral rib with its large and strong capitular and tubercular heads is undoubtedly sufficiently strong and securely enough united to the ilium and the vertebra to meet the demands of terrestrial progression. The second sacral and first caudal ribs (Fig. 16) could not have played a very important role in the support of the body. As a matter of fact the second sacral rib has the appearance of an atrophying element. This would indicate that the primitive number of sacral ribs is greater than one.

I attempted to show in the discussion of the caudal vertebrae that the skeletal differences between the sexes in *Seymouria* is comparable to the difference between the sexes in Recent turtles and crocodiles. Also, as stated earlier, we must postulate a single intromittent organ for *Seymouria*, because the paired hemipenes of snakes and lizards do not alter the disposition of the chevrons between the sexes. Since the turtles, which first appeared in the Triassic, are considered to be a rather static group, it is not so surprising to find this method of fertilization in the Permian. It is contended by many biologists that independence of water as a fertilizing medium is one of the most fundamental evolutionary steps taken by the early tetrapods. It is very attractive to think that *Seymouria* inherited this character from its early ancestors but the present state of our knowledge contains neither confirmatory nor contradictory evidence.

If the above considerations in favor of internal fertilization for *Seymouria* are true, it is almost a certainty that the eggs were large-yolked. The presence of large-yolked eggs in the "survivors" of the early fishes, namely the sharks and lungfish, indicates that the tendency for an abundance of yolk in the egg appeared very early in the history of the vertebrates. This lends support to the contention that *Seymouria* produced telolecithal eggs and that the young came into the world competent to carry on in the environment of their parents.

As yet we have no indication regarding the incubation medium employed by *Seymouria*. It seems probable the land would be less hazardous than the water, where the eggs might be eaten by the larger fish, or the eggs would cease growth because of lack of oxygen. Most of the tetrapods today which lay large-yolked eggs do not use water as an incubating medium.

In the discussion of the pectoral girdle and fore limb I pointed out that the glenoid faced downward, outward, and backward and that the humerus was inclined downward at an angle of about 45°. The glenoid is placed rather low on the side of the body so that the angle at which the humerus operated would have held the body clear of the ground. In walking the humerus moved from a position at nearly right angles to the body to a position nearly parallel to the body at the end of the stride. This gives *Seymouria* as complete a stride as the contemporary reptiles and larger terrestrial amphibians.

The acetabulum is broadly open ventrally with a strong dorsal lip which projects rather far laterally above the rest of the acetabulum. For the dorsal lip to receive the upward thrust of the femur (which it obviously did) the latter would have to have been inclined downward at an angle of about 45°. The acetabular articulation of the femur sits squarely across the proximal end. As near as can be determined from the form of the tibia and the form of the tarsal elements the toes of the foot extended forward as in the pelycosaurs and not laterally as in the lizards. Also the shape of the tibiale seems to forecast the condition found in the pelycosaurs.

The ilio-femoralis muscles are weaker than usual for most terrestrial vertebrates and undoubtedly this was something of a handicap. This was offset in part by the large dorsal lip of the acetabulum and the strong pubo-ischio-femoralis internus and the ambiens. Consequently with the aid of the vertebrae *Seymouria* would have been able to sustain its weight off the ground more or less satisfactorily. It is not at all likely that *Seymouria* could have progressed with any great speed. It might have been able to make sudden darts, but it is doubtful if it could have caught much of its food in a fair chase. The principal handicap for any considerable speed is the high center of gravity of the body with respect to the points of suspension of the mass. This is shown by the fact that both the glenoid and the acetabulum are placed rather low down on the sides of the animal. In the contemporary reptiles, especially the more active pelycosaurs, the acetabulum, and to a certain extent the glenoid, is relatively much higher in respect to the body mass than in *Seymouria*. Consequently, due to the high center of

gravity, any attempt at speed would be apt to result in much floundering. However in normal walking the rigidity of the vertebral column, due to the very broad zygapophyses, would tend to prevent undue slumping on one side when that leg was lifted off the ground. In view of the above evidence we are justified in assuming that *Seymouria* could travel on land without any great difficulty.

If the tail has been restored correctly *Seymouria* was undoubtedly a good swimmer. The rather long neural spines and chevrons indicate a tail similar in shape to that of the alligator or crocodile. The method by which I calculated the length of the tail has been discussed in connection with the caudal vertebrae. This may not be the correct length, but it is probably nearly so.

Some workers have orally expressed the opinion that, because of the remnants of the slime canals above and below the eye, *Seymouria* was thoroughly aquatic. It is believed by those who have studied the sedimentation (Case, 1915, cites several authors who concur in his opinion) that the Clear Fork was a time with alternating very dry and very wet seasons. The principal aquatic forms of this period are *Trimerhorhachis* and *Diplocaulus*. There have been about twenty specimens of *Seymouria* collected in the Clear Fork. As near as I have been able to learn, none of these were associated with unquestionably aquatic forms. The material in the M. C. Z. was associated with two specimens of *Captorhinus*. The probable circumstances will be treated in a later paragraph. Therefore we are obliged to conclude that *Seymouria* was not confined to an aquatic existence.

However, there is no reason to believe that it did not "go swimming" occasionally, or its habits may have been similar to those of *Alligator mississippiensis*. If the latter case is true it will give us a possible explanation of the scarcity of its remains in the Wichita division of the Redbeds. In such a case *Seymouria* would have been easy prey for the large and active *Cricotus* and *Ophiacodon*, which are believed to have had habits similar to the alligator. *Seymouria* would have been too large to hide under stones and not strong enough to compete successfully with the larger forms. That it was able to accommodate itself to the drier regions where the permanent bodies of water were too small to harbor the large forms accounts for its survival to this late date. Whenever it ventured into the Wichita area, as we know it now, it probably fell prey to the larger forms. It was not till the extinction of *Cricotus* and *Ophiacodon* that *Seymouria* was able to invade this area.

A number of "pockets" containing several more or less complete

skeletons have been found in the Texas Redbeds. Below is a list of the principal discoveries.

Genus	Number of Specimens	Horizon	Locality
Seymouria	9	Clear Fork	West Coffee Creek
Captorhinus	2		
Captorhinus	1	Clear Fork	Cacops Bone Bed
Casea	2		
Cacops	6		
Varanops	6		
Conodectes	4	Clear Fork	Gray Creek
Dissorophus	6	Clear Fork	Indian Creek
Trematops	5	Wichita	West of Williams Ranch
Parioxys	2	Wichita	West of Williams Ranch

All of the above listed pockets contained more or less articulated skeletons, some having suffered before burial, but in most cases the damage done was due to recent exposure to the weather. All of the forms contained were capable of making good progression on land and some, such as *Varanops*, were undoubtedly very agile. It does not seem likely that specimens should have been overcome in such quantity and the skeletons have remained articulated, except at a time when these forms had sought a hiding place in which to remain quiescent during an unseasonable time of the year. If it is true that there was essentially a climate of alternating dry and wet seasons the first torrential rain might easily have caused the roof of their chamber to cave in, thus burying them alive. There is also the possibility of drowning, the animals being trapped by rising streams or by water accumulating on the surface and running down a crack. In the Great Plains I have often seen small caves and sink holes formed in the surface soil by the surface water running down a large desiccation crack after heavy rains. Such a place would be ideal for the medium sized Redbeds tetrapods to pass short unseasonable climatic periods and might, under certain circumstances, be converted into a death trap.

The struggles of the last survivors might easily have dismembered those which perished first. This would be more likely to happen in the case of drowning. If we can judge by the Recent reptiles starvation is not at all likely. According to Benedict (1932) the larger Recent reptiles can survive a two-year fast without noticeable harm.

As a summary we can say that *Seymouria* was equally at home on land or in the water. Its food probably consisted of invertebrates, small fish, and the young of other tetrapods. The eggs were large-yolked and the young were as well fitted for a terrestrial existence as the young of the alligator. Because the eggs were large-yolked I feel that it is highly probable that they were deposited on land.

Relationships

I have only minor details to add to the previous accounts of the relationships of *Seymouria*. Watson (1918), Williston (1911), and Broili (1904) have clearly indicated its systematic position. The account by Watson (1918) is the most detailed and gives us a very clear conception of the evolution of many parts of the skeleton, particularly of the skull. I shall draw heavily on his account in my treatment of the subject.

Only *Seymouria*, *Captorhinus*, and *Labidosaurus* among the reptiles show the reticulate sculpture of the skull roof characteristic of the Temnospondyli. *Seymouria* seems to have the reticulate pattern a little better defined than the other two. The presence of remnants of slime canals above and below the eye is a feature as yet unknown in any other reptile. It would seem that the presence of these canals (if they are really slime canals) around the eye indicate that they probably served some physiological function in connection with that organ, since they are absent from the remainder of the skull and the lower jaw.

Seymouria is unique among the reptiles in possessing the full complement of bones in the skull roof and lower jaw. This is undoubtedly a character inherited directly from the Embolomeri and emphasizes its primitive position. The other cotylosaurs and many of the Rhachitomi have lost the intertemporal. Many of the latter possess three coronoids but most of the former have lost at least one.

In structure and mode of insertion in the socket the teeth suggest temnospondylan rather than reptilian affinities.

The form of the septomaxillary seems to forecast that of the higher cotylosaurs and pelycosaurs rather than that of Rhachitomi. The septomaxillary foramen is present but small. This seems to be a more or less presistent feature throughout the early reptiles even to the Therocephalia and Gorgonopsia.

That the lachrymal duct perforates the bone throughout its length is a characteristic reptilian feature. Watson (1913) feels that the condition in *Micropholis*, i.e. the lachrymal duct lying in a groove on the outside of the bone, represents an early condition. If this were true we

would expect to find a similar condition in the Embolomeri. At present we know of no embolomerous amphibian which shows this condition. The difference in time of the appearance of *Micropholis* and the earliest reptiles indicates that the condition in *Micropholis* is a specialization peculiar to that form.

The lachrymal bone borders on both the orbit and the nostril. This is a feature common to the Embolomeri and the early reptiles to the exclusion of many if not most of the Rhachitomi. *Seymouria* seems to be somewhat specialized in that the lachrymal is greatly restricted in its contact with the border of the orbit.

The frontal is excluded from the border of the orbit. This seems to be a feature common to most of the early tetrapods and is probably a primitive character.

The possession of an otic notch is undoubtedly a primitive character. However, I do not believe that the condition in *Seymouria* can be looked upon as an intermediate stage between the Embolomeri and those reptiles without the notch. A comparison of *Palaeogyrinus* and *Seymouria* leads one to believe that in the latter the otic notch has been incised into the squamosal and represents an enlargement rather than a reduction of the notch. In this respect *Seymouria* has become specialized.

The tabular differs from that of most Temnospondyli and Cotylosauria in that it overlaps the opisthotic at both the median and lateral ends. Thus the posttemporal fenestra is bounded above by the tabular and below by the opisthotic. Among the early tetrapods *Seymouria* shares this feature with *Anthracosaurus* alone. In view of this resemblance, it is entirely possible that *Anthracosaurus* may eventually prove to be a primitive seymouriamorph. As yet, *Anthracosaurus* is known only from an imperfect skull from the Lower Carboniferous of Scotland.

The peculiar otic capsule of *Seymouria* is, in the light of our present knowledge, unique among the tetrapods. Nearly all of the Embolomeri, which have been studied so far, have been not only badly crushed but preserved in an extremely difficult matrix. The braincase of these forms has been interpreted in the light of the braincase of *Eryops*, which is a rather advanced rhachitomous amphibian and the best known member of that group. It is altogether possible that when a well preserved embolomerous amphibian is found in a less refractory matrix the details of the otic capsule will agree very closely with *Seymouria*.

The paroccipital process is composed of both the proötic and the opisthotic. This is essentially a temnospondyl character. In the

higher reptiles the proötic has receded from the outer end of the process. *Seymouria* seems to present the primitive condition.

In view of the difficulty of making any satisfactory comparisons with any of the known Embolomeri, except *Anthracosaurus*, it is interesting, though perhaps presumptive, to attempt to homologize the otic capsule of *Seymouria* with that of the crossopterygian *Megalichthys* (Romer, 1937, p. 50–2). If any correlation is possible between the otic regions of these two forms there are several points which would appear to be homologous. The dorsal articulation of the hyomandibular in *Megalichthys* would seem to be equal to that portion of the proötic just above the fenestra ovale in *Seymouria*. The ventral hyomandibular articulation would then equal the foramen ovale (Romer, 1937, p. 50). It seems highly probable that the jugular canal and the groove anterior to it in *Megalichthys* is equal to the groove on the anterior side of the proötic in *Seymouria*. In support of this interpretation is the fact that the hypotic (hyomandibularis) branch of VII opens into the groove near the medial end in both forms. The foramen for the lateralis branch of VII occupies the same relative position in both. The small ventrally directed process on the proötic of *Seymouria* appears to be the last remnant of the vertical ridge of the parotic process of *Megalichthys*. The "paroccipital" process of the latter would equal the paroccipital portion of the opisthotic in *Seymouria*. One feature which does not lend itself to these comparisons is the canal which supposedly enclosed the proximal end of the stapes. Presumably the parasphenoid had ossified over the ventral part of the braincase in an ancestral tetrapod while the braincase still ossified as a unit, and this area had not yet started to migrate medially. There is really no evidence that the above mentioned canal in *Seymouria* enclosed the proximal end of the stapes. It is only an assumption based upon the superficial similarity to *Rana catesbiana* Schreber. If the above supposed homologies are true, *Seymouria* has the most primitive otic region of any known tetrapod.

The absence of an ossified supraoccipital is undoubtedly a specialized feature. Other features of the braincase indicate that *Seymouria* was undergoing progressive arrest of ossification in the skeleton.

The exoccipitals are not, as Watson (1918) thought, overlapped by a flange of the dermosupraoccipital, but abut against a facet on the upper portion of the opisthotic above the vagus foramen. In those reptiles in which the exoccipital is separate from the opisthotic the two meet above the vagus foramen. This character of the exoccipital is one which *Seymouria* has in common with *Anthracosaurus*.

The presence of a hypoglossal foramen is a character common to most tetrapods with the exception of the Recent Amphibia. Consequently it does not have any great phylogenetic significance.

The basioccipital of *Seymouria* is somewhat flattened, so that together with the exoccipitals the condyle is a little wider than high in crosssection and not circular as in the Embolomeri and higher reptiles.

The braincase is floored by cartilage as is the case in most early tetrapods. In the more advanced cotylosaurs and other reptiles the basicranium is fully ossified. A basicranium (Walker Mus. No. 871) referable to *Cricotus* has the floor unossified. The same is true of most of the Rhachitomi. This seems to be a primitive character.

The internal carotids enter the basisphenoid just behind the basipterygoid process. In some Rhachitomi they enter in front of the process, while in the above mentioned specimen of *Cricotus* they lie in a groove on the side of the basisphenoid. The point of entrance of the internal carotids in *Seymouria* is definitely a reptilian characteristic.

There is a movable articulation between the basipterygoid process and the pterygoid. This is a character common to the Embolomeri and most Reptilia which has been lost in most Rhachitomi

The palate with the small parasphenoid, and the broad pterygoids meeting in the midline behind the prevomers are characters which show the affinities of *Seymouria* to the Embolomeri. Although the palate of the Embolomeri is not, according to Watson (1926), completely closed, it would not be difficult to derive the condition in *Seymouria* from that of *Orthosaurus*. In this respect *Seymouria* has not advanced toward the reptilian condition.

The solid sphenethmoid of the Embolomeri has broken up into paired orbitosphenoids in *Seymouria*. In most Rhachitomi, except *Trimerorachis*, this region is a solid mass of bone. In many other reptiles in which this area is ossified there are paired orbitosphenoids.

The epipterygoid, while not known in *Seymouria*, is present in the closely allied *Conodectes*. In the latter it is a broad flat plate of bone, similar in form to that of *Eryops*, sitting more or less at right angles to the axis of the skull. It bears the median projection which is present in *Palaeogyrinus* and *Eryops*. On the whole the epipterygoid seems to be more amphibian than reptilian in its characteristics.

The tubera basioccipitalia are large and well developed. They are largely formed in cartilage and covered over by an extension of the parasphenoid. Small tubera are present in the aforementioned specimen of *Cricotus* and are formed in much the same way. The Rhachitomi, as a group, present much variation in the tubera. In *Eryops* they

are quite small, but in *Trematops* they are as large as in *Seymouria*. In *Captorhinus*, among the cotylosaurs, tubera are absent (Price, 1935). It would seem that the presence of tubera is a tetrapod characteristic rather than a reptilian one.

The internal nares of *Seymouria* are located near the midline. It shares this character with the Reptilia to the exclusion of the Temnospondyli.

While there are many characters which *Seymouria* shares with both the Reptilia and Embolomeri, as now understood, there are only two exclusively reptilian characters in the skull. They are: the position of the internal nares, and the penetration of the basisphenoid by the internal carotid behind the basipterygoid process.

As is well known, the expanded neural arches and broad zygapophyses are characteristic of the cotylosaurs as a group, with the possible exception of *Solenodonsaurus*. Outside the cotylosaurs, the mesosaurs and the primitive pelycosaur *Poecilospondylus francesi* Case, have swollen neural arches. Of the cotylosaurs *Seymouria* shows this character to the greatest degree (Table 2). In it the breadth across the zygapophyses is more than three times the transverse diameter of one end of the centrum while in the others, except *Diasparactus*, the breadth is about twice the diameter of the centrum.

Table 2

Comparative measurements of mid-dorsal vertebra of various early tetrapods.

Name		Transverse Diameter of Centrum	Breadth across postzygapophyses
Seymouria	young	11	29
	adult	11.5	37
	very old	13	48
Captorhixus		4	7.5
Labidosaurus		15	28
Diadectes		35	78
Diadectoides		17	36
Ltmxoscelis[1]		31	65
Diasparactus[1]		23	66
Cricotus		21	21
Ophiacodon uniformis		19	19
Dimetrodon limbatus		37	35
D. natalis		17	15

[1]Measurements taken from the literature.

I have expressed the belief in a preceding paragraph that the broad zygapophyses served as an aid in maintaining the balance while the animal was walking. They would permit the body to undulate laterally but would prevent any twisting of the vertebral column, and hence any slumping of one side of the body when that leg was lifted from the ground. The mechanical advantage of the short segmental muscles, namely the interarticular, would be much greater in the forms with the broad zygapophyses than in a form like *Dimetrodon*, for example. All of the American cotylosaurs which we know, had very weak ilio-femoralis (gluteal) muscles. Gregory and Camp (1920) have shown that these muscles are very important in maintaining the balance of an animal while it is walking. Thus the broad zygapophyses of the cotylosaurs fill a mechanical need. The cervicals and caudals would not be involved in the twisting of the trunk. That they have retained more nearly normal arches would lend support to the above argument.

Since we have in *Seymouria*, a primitive form which has survived until Clear Fork times, the weakest gluteal muscles and the broadest zygapophyses of any of the cotylosaurs, it does not necessarily indicate that broad zygapophyses are a primitive character. There is evidence in the material in the M. C. Z. that the relative breadth of the zygapophyses increases with age. It would seem then that *Seymouria*, which has remained conservative in most of its features, and in some has advanced very little beyond the Embolomeri, has become highly specialized in the vertebrae of its trunk. As Romer (1925, p. 462) points out, the interpolation of a form with swollen arches between the Embolomeri and the higher reptiles is not compatible with our present concept of the processes of evolution. It is conceivable that the Anapsida very early split into at least two main branches: one which sought to maintain the balance while walking by expanding the zygapophyses (the Cotylosauria as now understood), and the other which tended to develop the ilio-femoralis (gluteal) muscles and became extinct through evolution to higher forms before any of the known beds which contain reptilian remains were deposited. It is entirely possible that *Solenodonsaurus janenschi* Broili from the Gaskohle of Bohemia belongs in the latter group. However Miss Pearson (1924, p. 340) states that in the specimen she studied, "The arches are squat and low, as in *Seymouria*, the zygapophyses wide apart, and the neural spines apparently undeveloped." The remains were those of a very young individual in which the two halves of the neural arch had not united but were opened out with their dorsal ends touching. They

were situated in the slab so that the ventral and medial surfaces were exposed and the dorsal surfaces were buried in the matrix. Under the circumstances the evidence that the arches were "squat and low" is not conclusive.

A close comparison of Broili's (1924) excellent plate with the vertebrae of *Cricotus* shows us that the principal differences between the two are in the character of the diapophyses and the absence of a complete intercentral ring in *Solenodonsaurus*. Romer (1925, p. 462) quotes a letter from Broili in which he says that although the vertebrae were crushed somewhat they were not wide but narrow. Had this specimen possessed the "widely separated zygapophyses" as Miss Pearson (1924, p. 340) states, the lateral crushing which it suffered would not have left the zygapophyses in so near the correct relation to the rest of the vertebra.

On a recent visit to Harvard (1937), Prof. Watson insisted that the non-articular surfaces of the zygapophyses were neatly rounded in *Solenodonsaurus*. The same is true of *Cricotus*, a vertebra of an embolomerous amphibian in the M. C. Z. from the Coal Measures of Scotland, and *Parioxys*. It would appear then that the rounded non-articular surfaces of the zygapophyses is probably only a primitive tetrapod character and does not necessarily indicate widely separated zygapophyses. Also Prof. Romer pointed out in a recent conversation that rounded arches are to be correlated with horizontal articular surfaces. If rounded zygapophyses are a character of primitive tetrapods, the condition in *Poecilospondylus* and the Mesosauria could be explained on this basis.

As pointed out by Prof. Watson (1918, p. 290), the atlas of *Seymouria* is unique among the tetrapods. I do not know of any other form in which the centrum of both the atlas and axis are unfinished on the ventral side. While essentially reptilian in their main features the reduced centra and very large intercentra are somewhat perplexing. Whether this duplication of form can be considered a primitive character or an example of polyisomerism (Gregory, 1935) is not readily apparent. The atlas and axis are unknown in the Embolomeri. In the more advanced reptiles nothing comparable to the condition in *Seymouria* is known. In the light of our present knowledge, the character of the atlas and axis would seem to be an aberrant feature not intermediate between the Embolomeri and the higher reptiles.

Prof. Watson (1926) has shown that in the Carboniferous Embolomeri the ilium lay upon three ribs in the posterior part of the body in the same manner as the scapula does in the anterior. Whether or not

the vertebrae bearing these ribs should be called "sacral" is a purely academic question. In view of their function I see no possible objection to Prof. Watson's use of the term. I have expressed the belief in a preceding paragraph that the primitive number of sacral vertebrae was probably three. Certainly the disposition of the vertebrae and ribs in this region in *Seymouria* would tend to support this view. In most reptiles the first sacral rib and vertebra assumes more of the load of supporting the body than any one of the others. In *Seymouria* it assumes nearly the entire load. It was only through some exceptionally well preserved material that I was able to determine the presence of the second sacral rib. It is small and has the appearance of being an atrophying element. The first caudal, which, by stretching the term, might be considered a third sacral, could have been united to the ilium only by muscles or ligaments or both. Consequently in its evolution the sacrum of *Seymouria* has progressed very far towards the condition of a single sacral rib and, as in the case of the atlas and axis, cannot represent an intermediate condition between the Embolomeri and the higher reptiles.

All of the ribs of *Seymouria* are two-headed. In this respect they agree with the Embolomeri. I am entirely in agreement with Watson (1918, p. 280) that this is a primitive condition. Prof. Romer tells me that in the pelycosaurs the ribhead is divided by a shallow groove for the vertebral artery. This feature is shown only in the very old specimens, but is essentially a two-headed condition.

The peculiar manner in which the subscapular ribs are enlarged is, I believe, an aberrant feature. In nearly all terrestrial vertebrates these ribs are normally larger and stronger than the others. In *Eryops* and *Diadectes* the subscapular ribs are considerably broader than the others. Each overlaps the next one behind but are not vertically disposed as in *Seymouria*.

Prof. Watson (1918, p. 291) indicated the belief that the double-headed caudal ribs of *Seymouria* were unique among the tetrapods. In the more recently collected material in the M. C. Z. is a partial skeleton of *Eryops* which shows that at least the anterior caudal vertebrae bore double-headed ribs. As yet no additional case has come to light.

The scapula of *Seymouria* differs from that of the contemporary reptiles and amphibians in that it lacks the curvature of the blade characteristic of those forms. This is, I believe, an aberrant feature correlated with the peculiar thoracic ribs. The scapula fuses with the precoracoid rather late in life. This is an advance toward the reptilian

condition. The posterior end of the glenoid is less well ossified than the anterior. This may forecast a cartilaginous coracoid. The presence of a single foramen in the precoracoid is a distinct reptilian feature. The position of the supraglenoid foramen is probably the primitive one. In most cotylosaurs and labyrinthodonts it occupies the same general position, while in most pelycosaurs it has moved anteriorly onto the blade of the scapula.

The very small and featureless cleithrum indicates that it is a disappearing element. In this respect *Seymouria* has advanced well towards the condition in the higher reptiles.

The clavicle appears to have remained rather conservative. The sternal portion is perhaps a little broader than in the Embolomeri but not much more so than in the contemporary tetrapods, except *Eryops*. The scapular process, while not as broad as in the Embolomeri, is much broader than in the contemporary forms. This would appear to be a primitive character.

The anterior portion of the interclavicle is undoubtedly much enlarged over the condition in the Embolomeri and Rhachitomi. Possibly this can be correlated with the spread of the "thoracic" ribs and the need for better muscle attachment for terrestrial progression. The long posterior process is very definitely a reptilian feature as yet unknown in any labyrinthodont.

The humerus is of the general *Eryops-Diadectes* type, which may be a specialized feature not intermediate between the Embolomeri and the higher reptiles. It would be as easy to derive the humerus of *Dimetrodon* from *Cricotus* as from *Diadectes* or *Seymouria*. The entepicondylar foramen is characteristic of the reptiles but is no longer a certain criterion for placing a form in that group.

The radius, ulna, and foot do not offer any evidence regarding the affinities of *Seymouria*.

The ilium presents a combination of primitive features and specializations to fit the particular needs of *Seymouria*. There is little doubt that the long posterior process is a primitive feature inherited from the Embolomeri. Its success as a part of the ilium is that it was carried over to the pelycosaurs and also to the lizards. The blade of the ilium, while superficially similar to that of *Dimetrodon*, really is not homologous (Romer, 1922), but obviously developed out of the condition in *Cricotus*. It is conceivable that *Seymouria* may represent an early stage in the transition from the Embolomeri to a form like *Dimetrodon*, in first developing a strong attachment between the ilium and the sacral ribs. The next step to facilitate progress would be to

shorten the sacral ribs without changing the relation of their distal ends to the acetabulum. This relation is the same in *Cricotus* and most of the cotylosaurs and pelycosaurs. This would raise the point of suspension with respect to the center of gravity. The body functions would in turn necessitate a deepening of the pelvis below the acetabulum. In this case the shortening of the sacral ribs would be accompanied by a shortening of the iliac blade. It is conceivable that a shortening of the iliac blade of *Seymouria* could produce essentially the condition found in *Varanops*. As shown by Romer (1922) the transverse lateral line is the definitive top of the ilium. In *Seymouria* the transverse lateral line lies a little above a point opposite the lower extent of the first sacral rib. An intensification of this muscle scar in *Varanops* is all that is necessary to produce the condition in *Ophiacodon*. A continuation of the same process would produce *Dimetrodon*.

The dorsal lip of the acetabulum is more pronounced than in the contemporary forms. This is undoubtedly an adaptive feature so that it may receive better the upward thrust of the femur.

The ridge on the medial side of the ilium which marks the posterior limit of the pubo-ischio-femoralis internus is located as far posteriorly as in *Dimetrodon*. In *Cricotus*, most Rhachitomi, most cotylosaurs, and the more primitive pelycosaurs it is near the anterior edge of the ilium. Obviously with this extreme development it cannot represent an intermediate condition.

The pubis is relatively much larger than Watson (1926) describes for the Carboniferous Embolomeri, but is smaller and more squarish than that which Case (1915) referred to *Cricotus*. It is, also, smaller than in the cotylosaurs and pelycosaurs. In size the pubis seems to be intermediate between the Carboniferous Embolomeri and the higher Palaeozoic reptiles. With the possible exception of *Limnoscelis* there is no other Palaeozoic tetrapod in which the pubic tubercle is as large and prominent as in *Seymouria*.

The inclination of the pubis is more like that in the higher cotylosaurs than the nearly vertical pubis which Watson (1926) describes for the Embolomeri.

The ischium does not differ radically from that of the contemporary tetrapods.

The pelvic opening is large and more or less quadrangular, as it is in most reptiles except the dinosaurs, and not V-shaped as in *Eryops* and *Dimetrodon*.

The femur resembles most closely that of *Eryops*. I know of no other form in which the adductor ridge is developed to the degree that

it is in *Seymouria*. Probably, as Williston suggests (1911), this is a specialized feature and is too aberrant to be intermediate between the Embolomeri and the higher reptiles. No great change is necessary to derive the femur of the other Palaeozoic reptiles from that of *Cricotus*.

The nearly featureless tibia and fibula do not throw any light on the affinities of *Seymouria*.

As pointed out by Watson (1918), the tarsus is the most primitive reptilian tarsus known, in that there are three elements in the proximal row. Most of the other terrestrial reptiles have two, the intermedium and tibiale having presumably fused. The shape of the tibiale in *Seymouria* seems to forecast the condition in the higher Palaeozoic reptiles.

Summary

Seymouria shows in its skull structure closer affinities to the Embolomeri, as now understood (especially *Anthracosaurus*), than to any other known Palaeozoic reptile or amphibian. The postcranial skeleton has deviated far from the ancestral stock through adaptive modifications for terrestrial progression. The skeleton presents many specializations, because of which it is impossible to derive any of the higher reptiles from *Seymouria*. We must look upon *Seymouria* as an archaic form which has survived several epochs by finding an ecological niche where it would not receive much competition from more active forms. However, *Seymouria* is yet the most primitive reptile which we know at all well, and shows us many characters intermediate between the Embolomeri and the cotylosaurs and pelycosaurs.

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EXPLANATION OF ABBREVIATIONS

Skull

Ang — angular
Art — articular
Bo — basioccipital
Bpt — basipterygoid process
Bs — basisphenoid
C^1, C^2, C^3 — coronoids
CHa — canal for hypophysial artery
ChDPS — canal for dorsal process of stapes and dorsal end of hyoid arch.
CVCL — channel for venus capitis lateralis
Dent — dentary
Dso — dermosupraoccipital
Ecpt — ectopterygoid
Ept — epipterygoid
Exo — exoccipital
F — frontal
FAOp — Facet for articulation of opisthotic
FHA — foramen for hypophysial artery
FO — foramen ovale
It — intertemporal
Ju — jugal
La — lachrymal
Mx — maxillary
N — nasal
Nos — notochordal sheath
Opis — opisthotic
Osph — orbitosphenoid
Pa — parietal
Pal — palatine
Part — prearticular
PEndD — pit for dorsal end of endolymphatic duct
Pmx — premaxillary
Po — postorbital
Prs — presphenoid
Pro — proötic
Ps — parasphenoid
Psp — postsplenial
Pt — pterygoid
Ptf — postfrontal
Pv — prevomer
Q — quadrate
Qj — quadratojugal

Sang — surangular
Smx — septomaxillary
Sp — splenial
Sq — squamosal
St — supratemporal
Sta — stapes
Tab — tabular
Tb — tubera basioccipitalia
V — exit of fifth nerve
VII Hy — exit of hyomandibularis branch of seventh nerve
VII F — exit of facialis branch of seventh nerve
X+XI — exit of tenth and eleventh nerves
XII — exit of twelfth nerve

Scapulo-coracoid

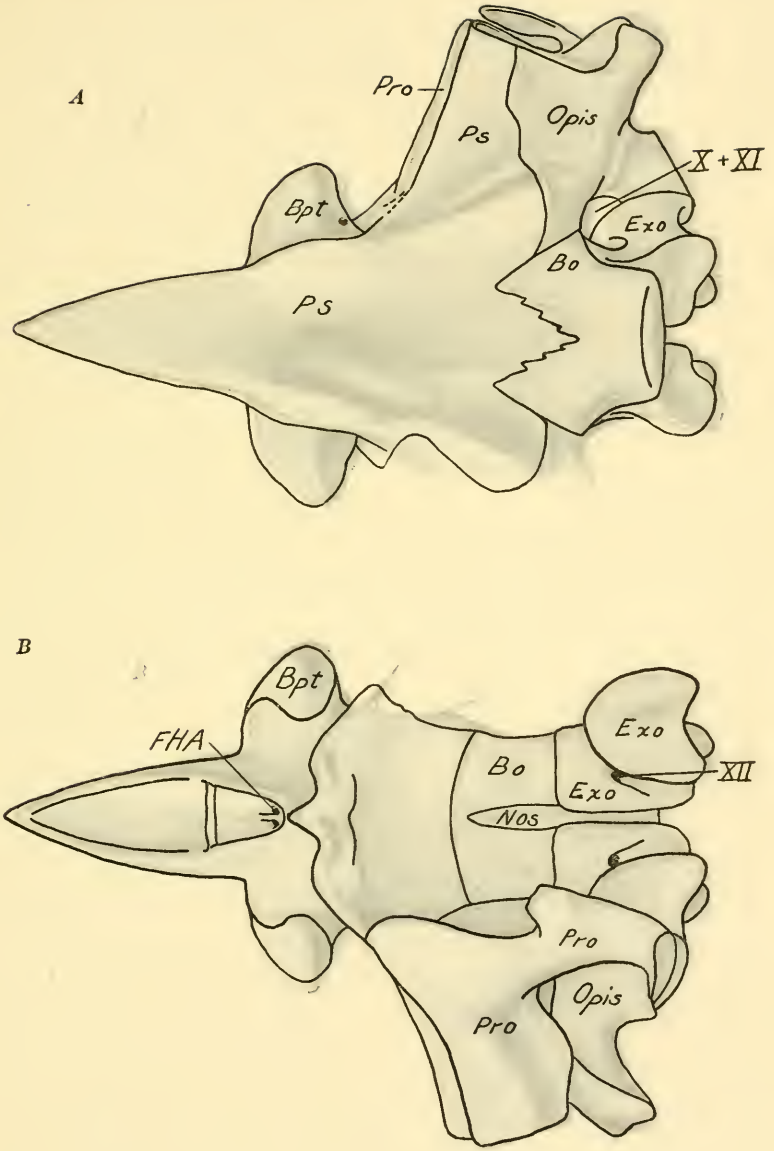
CFo — coracoid foramen
IGlF — infraglenoid fossa
NFo — nutrient foramen
MCA — mesacoracoid arch
SGF — supraglenoid fossa
SGlfo — supraglenoid foramen
SGlb — supraglenoid buttress
SScf — subscapular fossa

EXPLANATION OF PLATES

PLATE 1

PLATE 1

Plate 1. A, ventral and B, dorsal views of the braincase with right otic capsule removed. x 2.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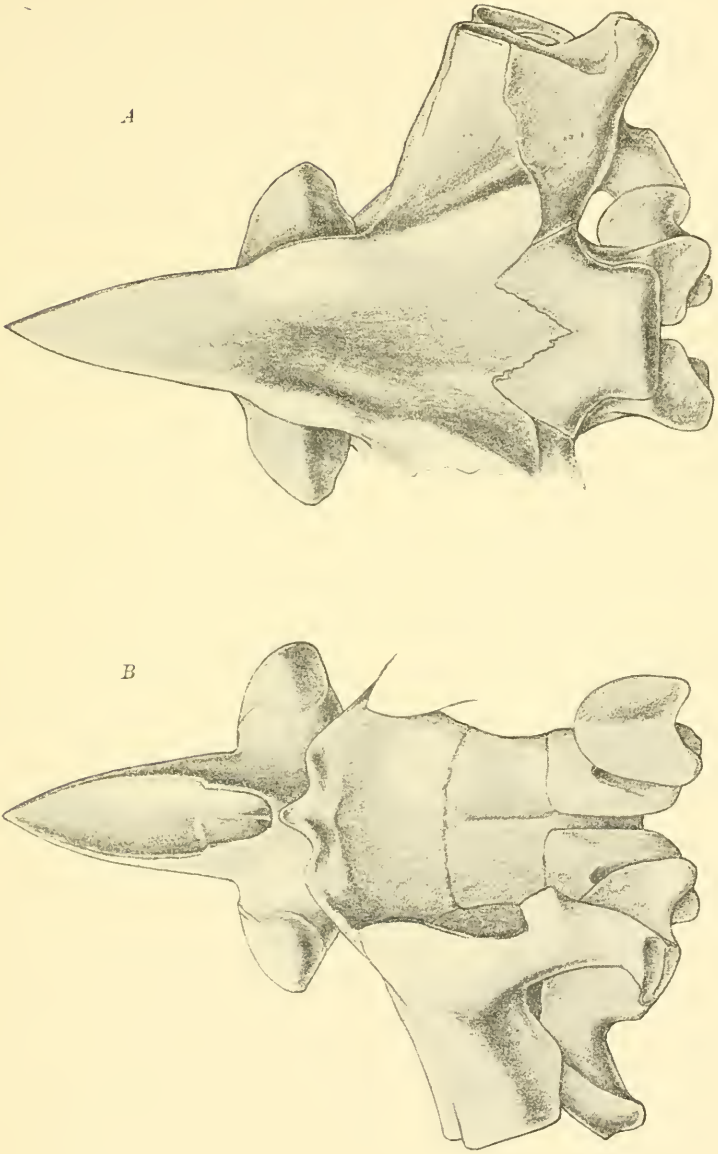
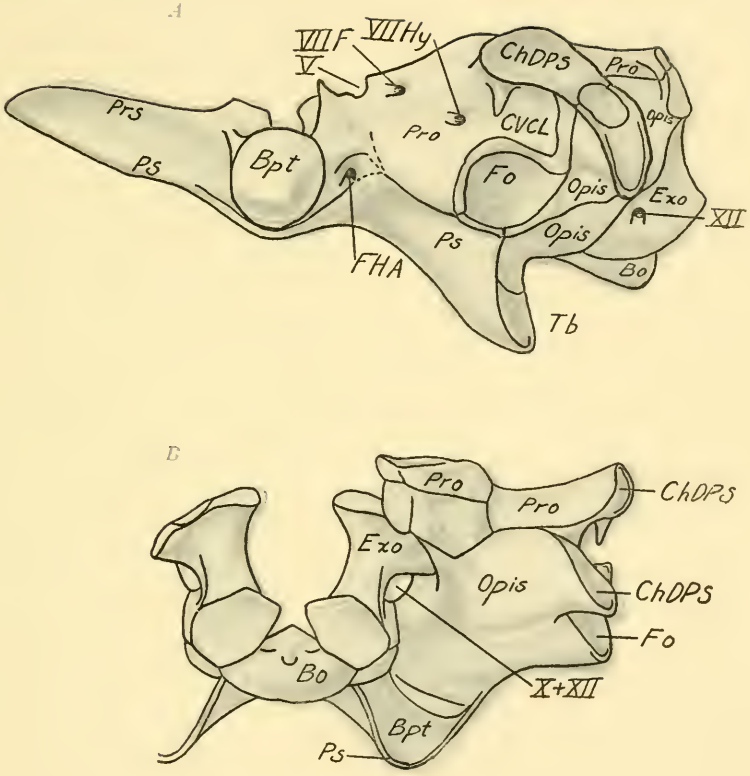

A
B

PLATE 2

PLATE 2

Plate 2. A, left lateral and B, posterior views of braincase. x 2.


A
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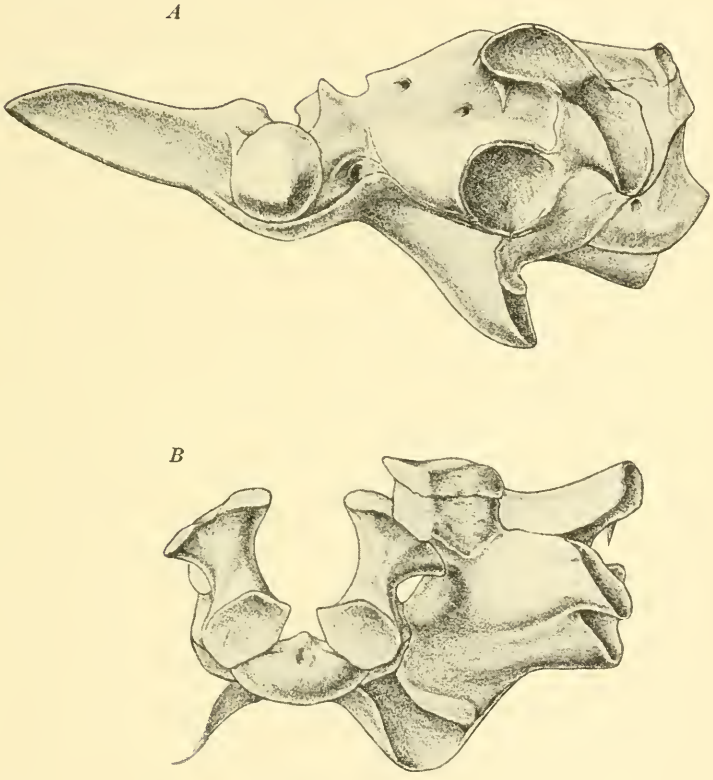
A
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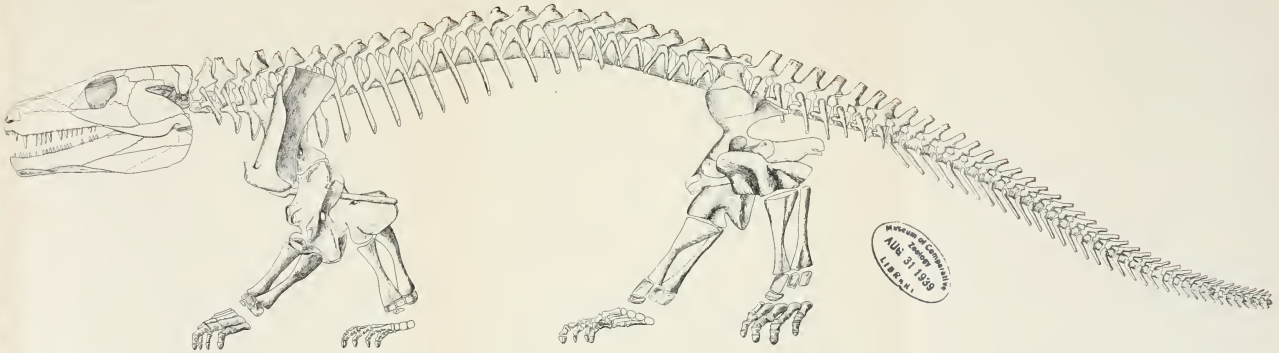
PLATE 3

PLATE 3

Plate 3. Restoration of the skeleton of *Seymouria baylorensis* Broili in walking attitude. x ½.



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FOSSIL PHORIDÆ IN BALTIC AMBER

BY CHARLES T. BRUES

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
SEPTEMBER, 1939

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No. 6.—*Fossil Phoridæ in Baltic Amber*

By Charles T. Brues

It has been known for many years that flies of the family Phoridæ are common in Baltic amber. In 1845 Berendt referred to their presence in amber and a few years later Loew ('50)[1] stated that he had been able to distinguish eleven species, but he gave no descriptions of any of them.

The first attempt to study the phorids of Baltic Amber was made by Meunier in 1909, in a paper entitled "Monographie der Leptiden und der Phoriden des Bernsteins"[2]. In this he described 20 species. Unfortunately, Meunier's descriptions are very incomplete and practically useless for recognizing his species, so that his contribution did little to further our actual knowledge of the Baltic Amber fauna. Later, in 1923[3], the present writer described two additional species.

This paper is based on a very fine series of Phoridæ recently acquired as part of the large Haren collection of Baltic Amber insects by the Museum of Comparative Zoölogy. It contains more than eighty specimens of Phoridæ, nearly half of which are in a sufficiently good state of preservation to identify specifically.

I have been able to recognize thirteen species, distributed in ten genera, and find much to my surprise that four of these genera are hitherto undescribed. It is clearly evident that the family was not only very well represented in Oligocene times, but that it was highly diversified and that some of the types were greatly specialized. As will be seen from the characterization of the new genera, there is clear evidence that several of these are to some extent intermediate between three sub-families, as currently recognized in the living fauna. Nevertheless, each presents highly specialized characters in addition to generalized ones. Most surprising perhaps is the genus Protoplatyphora, very evidently a near relative of the living Aenigmatias, which lives as an obligatory guest in the nests of ants. Only the male, represented by six specimens, is present in the material at hand, and it is very closely similar to the male of Aenigmatias. The living genus is apterous in the female and quite probably such may be true of the amber form, as one should hardly expect to find so many males without any corresponding females if both were winged. There is thus strong presumptive evidence that the highly degenerate, apterous females, now so common among living Phoridæ had already made their appear-

[1] Ueber den Bernstein und die Bernsteinfauna. Progr. Realsch., Meseritz, pp. 1–44.
[2] Jahrb. Königl. Preuss. Geol. Landesanst., vol. 30, pp. 64–90, 7 pls.
[3] Psyche, vol. 30, pp. 59–62.

ance in the Lower Oligocene. There are also representatives of five genera, Diploneura, Aneurina, Paraspiniphora, Triphleba and Megaselia. In addition Meunier has described a species of Conicera which may quite probably belong to this genus, although some doubt attaches to this statement, as there are several living genera with conical antennæ in the male.

I have been in a quandary as to what to do with the species described by Meunier. It has been utterly impossible to recognize any of his species in the present collection, and I have not been able to see any of his types. Whether they are now in the amber collection of the Geological Museum at Königsberg I do not know. Dr. F. M. Hull, who looked through the series of Diptera there two years ago, told me that he had seen a number of specimens of Phoridæ, but recognized no named specimens that had been studied by Meunier. I have therefore decided to describe the recent species without reference to those described by Meunier. This may by some be considered highly reprehensible, but as the material at hand is so extremely interesting and I see no immediate opportunity to search for Meunier's types personally, I have decided to follow this course; the present descriptions have been carefully drawn only from well preserved specimens and will I feel sure make the species easily recognizable for future workers.

The accompanying figures have been prepared, mainly from camera lucida drawings, by Mrs. A. S. O'Connor, to whom I am indebted for her cheerful and painstaking efforts in sketching from very difficult material.

Diploneura Lioy

There are three recognizable species of this genus known from the Baltic Amber, one described by the writer and two contained in the present collection. These may be separated as follows:

Key to the Baltic Amber Species of Diploneura

1. Third vein clearly forked 2
   Third vein simple or obsoletely forked, the second vein absent; first section of costa twice as long as the second. . *D. simplicior* sp. nov.
2. First section of costa less than one and one-half times as long as the other two together; costa extending nearly to the middle of the wing ..... *D. meunieri* sp. nov.
   First section of costa three times as long as the other two together; costa only one-third the length of the wing ..... *D. loewi* Brues.

DIPLONEURA SIMPLICIOR spec. nov.

♀. Length 2.2 mm. Apparently black, with the antennæ, palpi and fore legs lighter in color. Front at least as high as broad, perhaps slightly higher; bristles strong, but not excessively large, two postantennals separated by about one-fifth the width of the front; lower row of frontal bristles of four, the middle pair much lower than the lateral ones, at a level nearer that of the postantennals than the lateral ones of their own row and twice as far apart as the postantennals; preocellar row of four forming a straight transverse line, not quite equidistant, as those of the median pair are slightly further apart; ocellar row of four, in addition to a bristle directed inwards just behind the lateral bristle. Postocular cilia large, especially behind the middle part of the eye; cheek with one large downwardly directed bristle and at least one smaller one above toward the antennæ. Antennæ of moderate size, rounded, arista extending about to the vertex; palpi bristled below toward tips, none of the bristles very large; proboscis small, fleshy. Mesonotum rather broad, convex; one pair of dorsocentral bristles, with 4–6 rather conspicuous bristly hairs between them along the posterior margin; scutellum broad, with only two, very strong bristles, the lateral ones reduced to minute bristly hairs. Propleura with four slender bristles at the lower angle that spread out fan-shaped over the base of the front coxa, also one very conspicuous strong bristle just below the spiracle. Mesopleura smooth, entirely bare. Abdominal tergites covering the abdomen well down on the sides, the second slightly and the sixth greatly elongated. Legs rather slender, the hind femora but little thickened. Front tibia with a very short, very inconspicuous bristle just before the basal third and with 6–8 minute bristles along the apical half, the latter scarcely more than hairs; also with an area at tip anteriorly covered with transverse comb-like bristles. Middle tibiæ with a pair of rather short bristles at the basal fourth and two very small apical ones on the anterior surface as well as a long apical spur. Hind tibiæ without isolated bristles; with at least one dorsal hair-seam anteriorly and apparently with two, although the specimen cannot be viewed in a position to show a second one clearly; only one tibial spur. All tarsi slender. Costal vein not quite extending to the middle of the wing (27:60); very minutely, but distinctly and closely ciliate; third vein not forked, although with the bare suggestion of a short, coalesced branch in reflected light; first section of costa twice as long as the second (16:8); middle of first vein widely separated from the costa; fourth vein weakly curved at

base, straight beyond; fifth sinuate on apical half; seventh rather weakly colored.

Type ♀, No. 8100, M.C.Z.; male allotype, No. 8103.

This species seems to be definitely a Diploneura in spite of the absence of a fork in the third vein. The hind tibiæ cannot be seen in direct dorsal view, but there is clearly at least one seam-like line present.

Diploneura meunieri spec. nov.

♂. Length 2.1 mm. Apparently entirely black with hyaline wings. Head with the usual three transverse rows of reclinate bristles, all of them long and stout. Antennæ rather small, densely pilose; arista almost bare, long, extending as far as the tips of the median bristles on the vertex; postocular cilia long, especially near the middle of the eye; cheeks each with one large, downwardly directed bristle. Proboscis small, the labella noticeably geniculate at the base. Palpi small, with six or seven very strong bristles apically. Mesonotum elongate, strongly convex anteriorly; one pair of strong dorsocentral bristles. Scutellum arcuately rounded behind, with two long, stout bristles. Mesopleura entirely bare, without hairs or bristles above. Abdomen with the second and sixth segments each about one-third longer than the intervening ones which are subequal in length. Genitalia large, forming a globose mass extending below the apex of the abdomen. Legs rather slender, but the hind femora rather stout, nearly one-third as broad as long. Anterior tibiæ with a short rather stout bristle at the basal third; middle tibiæ at about the basal fourth with two long moderately stout bristles and one very long apical spur; hind tibia with a single dorsal hair-seam that extends to the tip and a second more posterior one that fades out near the apical third, without external bristles before the apex which bears two stout spurs. All tarsi rather stout, especially the front pair, the front metatarsus fully two-thirds as broad as its tibia. Costa reaching nearly to the middle of the wing, its bristles very short and closely placed; third vein forked; the second vein straight, rising sharply to the costa, no longer than the third section of the costa; none of the veins thickened; first section of costa longer than the other two together; third less than half as long as the second (13:7:3); fourth vein rather strongly curved at the base, straight beyond; seventh distinct.

Type. No. 8101, M.C.Z.

This species is referable to the subgenus Diploneura, *sens. str.*

There is another male (No. 8102) not so completely well preserved

that is probably this species. The small bristle toward the base of the front tibia is followed by a series of about seven gradually smaller bristles to the tip of the tibia; these grade into one another in size, the last one being very minute although still evidently a bristle rather than a hair.

Diploneura loewi Brues

Psyche, vol. 30, p. 61 (1923) (*Dohrniphora*).

This species was described from a single specimen in the collection of the Königsberg Museum. It is not represented in the present collection.

Aneurina Lioy

There is a single species of this genus, which has not been previously reported from the Baltic Amber.

Aneurina oligocœnica spec. nov.

(Fig. 1)

♀. Length 2.3–2.8 mm. Apparently black or dark colored, perhaps the antennæ and palpi lighter. Front wider than long, the frontal bristles large and stout; postantennal pair of bristles smaller than the others, close together, extending upwards and also outward; lower frontal row of four bristles with the middle pair arising considerably below the lateral ones and much further from one another than from the adjacent lateral bristle which is very close to the eye-margin; preocellar row forming a straight line, the median pair closer to one another than to the lateral bristle, arising considerably above the middle of the front; ocellar row of four bristles, straight, and in addition at each upper angle of the front is a smaller bristle directed upwards and strongly toward the median line. Antennæ good-sized, but not noticeably enlarged, with a long, slightly pubescent arista. Palpi of moderate size, with well developed, but not strong bristles. Postocular cilia strong, especially near the middle; cheeks each with one very long downwardly directed bristle and a series of weaker, but still large ones extending upward to the eye. Proboscis short, fleshy. Propleura with scattered bristly hairs, two long stout bristles on lower margin behind and one below the spiracle. Mesonotum rather narrow, strongly convex; scutellum with four bristles, the lateral ones short, the median pair unusually large; mesopleura entirely bare. Abdomen

with six completely sclerotized tergites, very sparsely beset with bristly hairs above; sixth tergite with four or six longer hairs on apical margin and a similar series on the apical margin of the venter. Legs long and slender, the hind femora four times as long as broad; front tibia with a very long stout bristle at the basal third, their tarsi slender, not at all thickened; middle tibiæ with a pair of long, thin bristles at the basal fourth and a few longer hairs along the outer edge on the apical

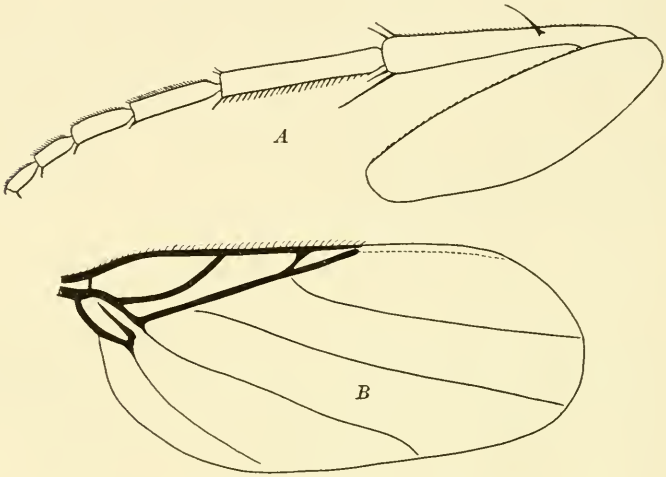

Fig. 1. *Aneurina oligocænica* sp. nov. *A*, hind leg; *B*, wing.

third, with a small preapical bristle on the anterior side, spur very long, nearly equalling the metatarsal joint; hind tibiæ with only a single antero-dorsal bristle at the base and with apparently only one apical spur, the preapical bristle very small. Costal vein extending to slightly beyond the middle of the wing, its bristles very short and closely placed; first section one-third longer than the second; third half the length of the second (16:12:6), none of the veins thickened, the first vein very strongly bowed, its middle portion unusually far from the costa; second vein strongly oblique; fourth vein curved at base, straight beyond; seventh distinct for its entire length.

♂. Differs in having the antennæ quite noticeably enlarged, fully half as long as the height of the eye and the preapical bristle on the hind tibia is longer. Hypopygium very large, bulbous.

Type female, No. 8106, M.C.Z. Two males (Nos. 8107, 8108), I think, are undoubtedly correctly associated. There is also a piece of amber, containing a group of three males which are probably the same, although they cannot be completely examined.

Chætocnemistoptera Borgmeier

There is one species in the present amber collection which is referable to this genus. The Miocene *Phora laminarum* Brues (1908) from the Florissant shales has been tentatively placed in this genus by Schmitz on account of its similarity to *Phora multiseriata* Aldrich. The latter belongs, however, to the very similar genus Chætopleurophora, as it possesses a single large mesopleural bristle, and such may be true of the Florissant form, although this is not preserved in the type and only known specimen.

Chætocnemistoptera electra spec. nov.

(Fig. 2)

♂. Length 2.7 mm. Color, as preserved very dark; wings slightly tinged with brownish, the veins piceous. Front rather wide, apparently wider than high, although not visible in direct frontal view.

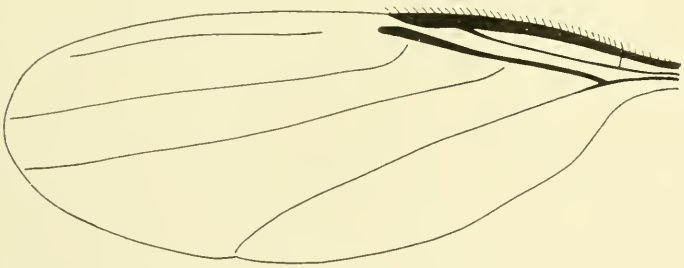

Fig. 2. *Chætocnemistoptera electra* sp. nov., wing of male.

Frontal bristles very stout and quite long; post-antennals absent (possibly broken off or very short, as the surface is clouded at this point); lowest frontal row of four equidistant bristles, the median pair set very much lower than the lateral ones; middle row also with the median pair of bristles considerably lower than the lateral ones. Antennæ slightly larger than usual, with a bare arista that extends

well above the vertex. Palpi of moderate size, with stout, but not very long bristles below toward the apex. Cheeks each with one large bristle below and a series of smaller ones extending upward toward the antenna; postocular cilia enlarged near the middle of the eye. Mesonotum strongly convex in front and flattened behind, rather narrow; one pair of dorsocentral bristles and two marginal scutellar bristles. Mesopleura hairy on its upper half, but without any long, backwardly directed bristle. Second abdominal tergite only slightly longer than the third. Hypopygium large, the lateral lobes fringed with short twisted bristles. Front tibiæ with a very stout bristle at the basal third, bare beyond; middle tibiæ with a long and rather stout pair at the basal fourth and a shorter, but well developed bristle on the anterodorsal side before apex; hind femora very stout, their tibiæ without isolated bristles but apparently on the dorsal side with a series of transverse rows of minute comb-like bristles. The tibia cannot be viewed directly on this surface, but the rows of bristles show clearly in profile. Costa three-eighths the wing length (31:80); costal fringe very minute and closely placed, the costa strongly thickened, widest near the middle and tapering toward each end; first section more than one and one-half times as long as the second (17:10); third vein simple, without any trace of a fork. Fourth vein weakly sinuous, ending practically at the wing-tip; fifth vein nearly parallel and close to the fourth; sixth widely separated from the fifth; seventh distinct.

Type male, No. 7689, Museum of Comparative Zoology.

I have experienced considerable difficulty in placing this species generically, but believe that it can be properly referred to Chætocnemistoptera. The hind tibiæ entirely lack isolated bristles, but in many genera there is extensive variation in the tibial bristles on this pair of legs. Also the third vein is entirely without even a trace of furcation, but that is already known in one living species of the genus. The most important discrepancy is the absence of the post-antennal bristles, and, as the specimen is so perfect, I cannot believe that these have been broken off. Unfortunately the surface of the front is obscured by a thin whitish veil and the insertions of such bristles could not be detected if present. Among the genera with unforked third vein, this species would fall in Borophaga, but it does not have the stout habitus nor strongly bent fourth vein. On the basis of the permutations of characters referred to we might be constrained to erect a new genus, but I do not feel that this is justified, especially as I am not satisfied that Chætocnemistoptera can be retained as distinct from Chætopleurophora.

Paraspiniphora Malloch

There are three species of this genus from the Baltic amber, one of which was previously described by the writer.

They may be distinguished as follows:

Key to the Amber Species of Paraspiniphora

1. Hind tibiæ with one bristle at the basal third and a pair at the middle; wing with a dark, thickened, oval swelling anterior to the tip of the third vein ..... *P. transita* Brues.
   Hind tibiæ with either a pair or three bristles at the basal third; wing without such thickened area 2
2. Hind tibiæ with a group of three bristles at the basal third, but none at the middle ..... *P. parvipalpata* spec. nov.
   Hind tibiæ with a bristle at the basal fourth, one at basal third and one at the middle ..... *P. schmitzi* spec. nov.

Paraspiniphora transita Brues

(Fig. 3*B*, *C*)

Psyche, vol. 30, p. 60 (1923) (*Dohrniphora*).

There are three additional specimens (Nos. 8110, 8111, 8112) of this very remarkable species in the present collection, which make it possible to add certain structural characters that could not be made out in the single Baltic Amber specimen from which the original description was drawn. The sex of the type was not determinable, but all three specimens now before me are females, so that it is probable that the type is of this sex also. The palpi are small with several moderately strong bristles at the tip and shorter ones well down toward the base; proboscis short, with short, broad, fleshy labella. Front tibiæ with about ten short bristly hairs along the front side forming a series between the large bristle and the apex; these are visible only when the leg is turned in exactly the correct position. In addition to the pair of bristles at the basal third, the middle tibia bears a bristle near the apical fourth of the anterior side; each of these three bristles is fully half as long as the tibia; tibial spur very long. All three bristles on hind tibiæ very long; one postero-dorsal at the basal third, one postero-dorsal and one anterior at the middle; two long tibial spurs and two apical spines just before tip on outer side. The second vein runs very close to the third, inclosing an almost linear cell between them, and the last section of the costa is slightly but noticeably thickened.

The species is easily recognizable by the swelling or welt in the wing below the apical part of the third vein. This structure is I believe unique in this subfamily, but there are a couple of species of South

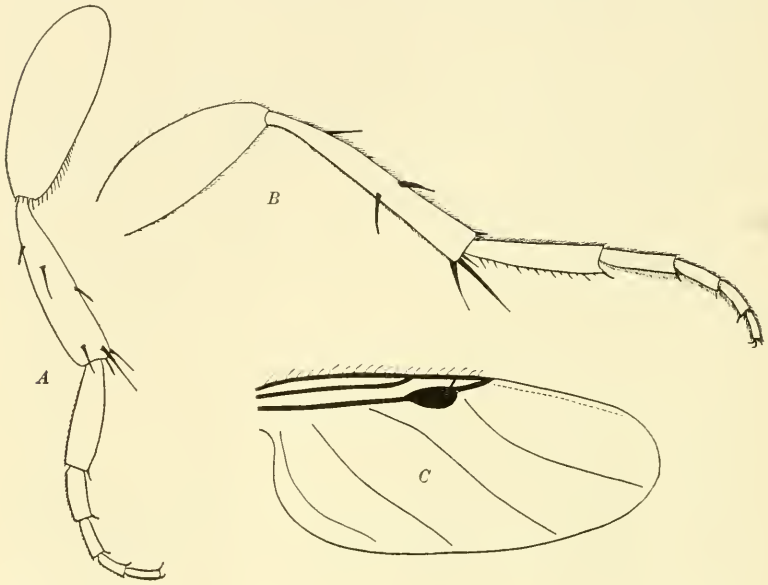

Fig. 3. *A*, *Paraspiniphora schmitzi* sp. nov., hind leg;
B, *Paraspiniphora transita* Brues, hind leg;
C, *Paraspiniphora transita* Brues, wing.

American Metopininæ with a similar thickened area located exactly as in the fossil species.

Paraspiniphora parvipalpata spec. nov.

(Fig. 4)

♂. Length 2.7 mm. A specimen in rather poorly preserved condition, but showing several striking characters. The body apparently dark, with probably the front legs yellowish; wings yellowish hyaline, with the veins light brown. Antennæ small, with short, thin arista. Palpi very small, not longer than the diameter of the third antennal joint, with minute bristles below on the apical half; proboscis small, fleshy, retracted. Frontal bristles long, especially above; two strong

postantennals. Scutellum with four bristles, two strong and extremely long medially and two shorter but still long lateral ones. Mesopleura bare. Legs long and rather slender, but with the front tarsi and hind legs beyond the femora decidedly thickened. Front tibiæ with a short bristle at the basal third; front tarsi flattened, the third and fourth joints but little longer than wide; middle tibia with a pair of strong bristles at about the basal third or fourth. Hind tibiæ with a group of

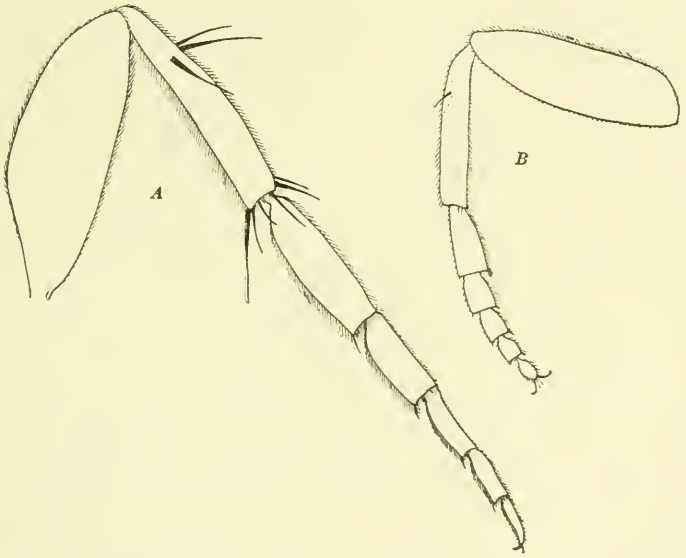

Fig. 4. *Paraspiniphora parvipalpata* sp. nov., *A*, hind leg; *B*, front leg.

three at the basal third, one dorsal, one postero-dorsal and the third anterior in position; the tip with several bristles in addition to the two apical spurs; metatarsus broad, the following joints growing more slender to the last which is very thin. Costa very long, extending much beyond the middle of the wing; its cilia very short and densely placed; first section but little longer than the second; third one-half as long as the second (19:15:8). Costa and veins thin, the third running practically straight along its entire course and well separated from the costa; second vein rising sharply and straight, so that the cell is quite evenly wedge-shaped. Light veins not clearly visible in the type.

One specimen, Type No. 8113, M.C.Z.

This species conspicuous on account of the very small palpi, the group of strong bristles near the base of the hind tibia, and the very long costa with extremely straight third vein.

Paraspiniphora schmitzi spec. nov.

(Fig. 3.1)

♂. Length 2 mm. Apparently black, brownish on the pleuræ; antennæ piceous; palpi yellow; legs yellowish brown on the four anterior tibiæ and the knees of the hind legs; wings hyaline. Frontal bristles large and stout, the postantennal pair somewhat smaller; middle pair of bristles in both the lower and middle rows set at a lower level than the lateral ones; postocular cilia strong; each cheek with a long bristle below and a series of about five smaller ones in a series extending upward toward the antenna. Antennæ somewhat larger than usual, with a stout arista. Palpi not enlarged, with moderately strong bristles apically. Mesonotum rather narrow, strongly bristly along the sides, one pair of dorsocentral bristles; two very large scutellar bristles and a much smaller, although still conspicuous lateral bristle near the side. Mesopleura bare above; propleura with a series of rather long bristles along the posterior edge. Abdomen with the second tergite scarcely lengthened; the sixth strongly so, its posterior edge fringed with bristly hairs; hypopygium large, rounded, without conspicuous hairs or bristles. Middle and hind legs rather stout, the front tarsi not at all thickened; front tibiæ with a short, stout bristle at the basal third followed by a line of short bristly hairs extending to the tip; middle tibiæ with a pair at the basal fourth and an anterior one not far before apex in addition to a long apical spur, the anterior surface with fine, more or less uniformly transverse rows of very minute comb-like bristles, more evident apically; hind femora fringed with a few bristly hairs below near the tip; hind tibiæ with a strong postero-dorsal bristle at the basal fourth, a stronger anterodorsal bristle at the basal third and a ventral one (not quite so large) at the middle in addition to two anterior ones and two apical spurs at the tip. Costal vein short, not reaching the middle of the wing (22:57), its bristles short and closely placed; first section twice as long as the other two together (15:7); second vein not very clearly to be seen, but it appears to rise sharply to the costa about midway between the tip of the second and third veins; fourth vein weakly curved at base, then running practically straight to the wing margin.

Type, No. 8114, M.C.Z., and one paratype (No. 8115) specimen. Named for Dr. Hermann Schmitz, S.J., in recognition of his valuable contributions to the taxonomy of this family of Diptera.

Triphleba Rondani

Triphleba præterita spec. nov.

♂. Length 1.2–1.4 mm. Apparently dark brown or black, the legs lighter, especially the front pair; antennæ brownish; palpi yellowish. Front smooth, more or less shining, about quadrate; postantennal bristles much weaker than the others which are very strong; lower frontal row of four equidistant bristles placed in a row that curves downward medially; preocellar row straight, midway between the vertex and the lowest lateral bristles; postocular cilia moderately strong, about equal; cheek with one downwardly directed bristle that is little larger than a series of about four that extends upwards toward the eye-margin. Antennæ rounded, perhaps a little larger than usual; arista bare, slightly thicker than usual near the base; palpi swollen and somewhat flattened, wider than the antennæ in ventral view and almost as wide in profile, fully as long as the width of the eye, entirely bare except for one small and sometimes a second extremely minute bristle at the tip; proboscis small. Mesonotum distinctly shining, strongly bristled along the sides; dorsocentral bristles weak; scutellum nearly as long as wide, with only two bristles, although these are very long and well developed. Mesopleura smooth, entirely bare. Second abdominal segment slightly lengthened. Legs short and stout; all tibiæ with bristles. Front tibia with a single weak bristle at the basal third, their tarsi noticeably, but not greatly thickened; middle tibia with a strong pair at the basal third, the anterodorsal one fully half the length of the tibia, also a weak anterior bristle barely before the tip and one long apical spur; hind tibia with one stout posterodorsal bristle just before the middle and one long and one very short apical spur. Costa extending almost to the middle of the wing (32:15), its bristles very short and closely placed; first section of the costa longer than the other two together; third a little shorter than the second (14:6:5); second vein thin, rising sharply to the costa; fourth vein very weakly curved; fifth and sixth feebly sinuous; seventh distinct for at least a part of its course as a fold, but this part of the wing is difficult to see in the specimen.

Type, No. 8116, M.C.Z. and two paratypes (Nos. 8117, 8118) which are quite surely conspecific; three additional ones are probably

the same and another doubtfully so. The palpi vary in size in several specimens, but such changes often happen in amber specimens, due to swelling or shrinkage.

The bristles on the legs are large and strong, but the species fits fairly well in this genus, which contains several living species with similarly enlarged palpi.

Conicera Meigen

Conicera eocenica Meunier

Jahrb. Königl. Preuss. Geol. Landesanst., vol. 30, p. 78 (1909).

There are no specimens of this species in the present collection, but it is quite probably a true Conicera. The description is very incomplete, as there is no statement concerning the bristling of the middle or hind tibiæ, nor as to whether the third vein is simple or forked.

Electrophora gen. nov.

♂. Front with 18 bristles, all sharply reclinate, in four transverse rows of four each and also an accessory bristle on each side not far below the lateral ocellar bristle; ocelli on a slight but distinct tubercle, the vertex forming a sharp, but not elevated ridge. Antennæ oval, with dorsal arista. Mesonotum broad, the propleuræ forming the humeri with the spiracle visible in direct dorsal view; dorsocentral and scutellar bristles present; mesopleura hairy above. Wings ample, but rather narrow apically; costa of moderate length, bristly; third vein simple, its surface bare; four light veins. Tibiæ with spines before apex; all femora slender.

Type, *E. persetosa* spec. nov.

I am unable to place this peculiar form in any described genus without disregarding some obvious character, especially the unusual chætotaxy of the front. All of the frontal bristles are completely reclinate and the lowest row of four are well removed from the lower margin, giving the impression that the postantennals are absent, in spite of the otherwise large number of bristles on the upper part of the front.

Electrophora persetosa spec. nov.

(Fig. 5)

♂. Length nearly 3 mm. Apparently black or dark colored, including the legs, with hyaline wings. Antennæ oval, of moderate size,

the arista practically bare. Front visible only in oblique view, but the front appears much wider than high; frontal bristles of small or moderate size; lowest row of four (postantennals?) arranged in two pairs, one placed at about the middle of each side, so that each pair is separated from the other and from the eye-margin by twice the distance between the members of each pair; next row above forming a nearly straight tranverse row, its bristles about equidistant, with the lateral one half

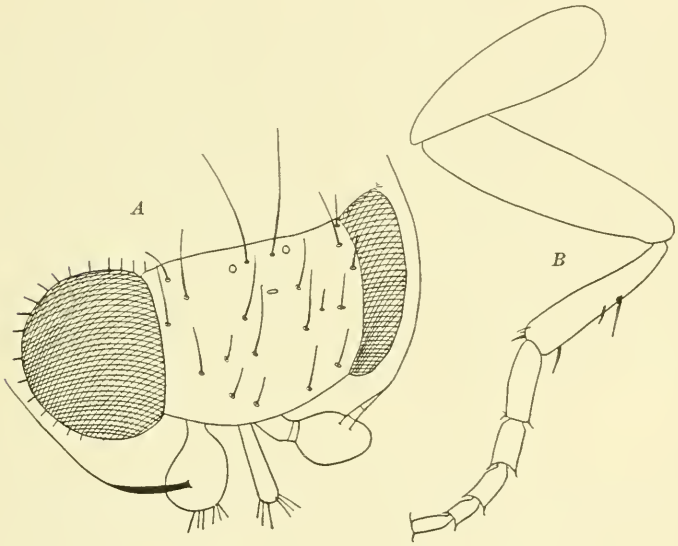

Fig. 5. *Electrophora persetosa* gen. et sp. nov., *A*, oblique anterior view of head; *B*, hind leg.

as far from the eye as from the adjacent bristle; preocellar row curved upwards at the sides, of four equidistant bristles with the lateral one close to the eye, and just above this and farther from the eye is the supernumerary bristle; ocellar row as usual, next to the sharp vertex. Postocular cilia all well developed, especially long near the middle of the eye; cheeks each with one long, downwardly directed bristle. Palpi club-shaped, small, with about six strong bristles at apex; proboscis short and inconspicuous. Mesonotum broad, its posterior portion and scutellum not clearly visible in the type specimen but one pair of dorsocentral bristles are present and at least one, probably two pairs of scutellar bristles. Mesopleura hairy above, but without a

long bristle (none is present in the type and there is no indication of a socket where it may have been inserted). Abdomen visible only at the apex and obscurely on upper surface; sixth slightly elongated; hypopygium bearing on the underside a pair of large oval pieces, the one on the right side contracted at apex into a spatula-like projection; lamella short, bristly at tip. Anterior tibia with a moderately long, stout bristle externally just before the middle, and just beyond this a small, but clearly differentiated bristle, also an external bristle distinctly before apex; middle tibia with a longer, more slender pair at basal third and also a very small, but evident bristle just beyond the anterior one of the pair; hind tibiæ with a dorsal bristle near the basal third and an anterior one just beyond. Beyond the bristles of the four anterior tibiæ the outer surface is clothed with minute bristly hairs; these appear to be present, but much less conspicuous on the hind tibia; front tarsi noticeably thickened, especially toward the base. Costa almost half the wing length (35:74), its bristles extremely short and closely placed, first section fully four times as long as the second (22.5:6); third vein stout, but not thickened apically; fourth vein very weakly and uniformly curved; fifth slightly sinuous; sixth widely separated from the fifth; seventh distinct.

Type, No. 8119, M.C.Z. No other specimens.

Hypoceridites gen. nov.

All three pairs of legs with large isolated bristles on the tibiæ before apex; postantennal bristles proclinate, those of the lower frontal row erect or directed laterally downwards; costa very short, bare except at base; third vein forked at tip to form a very minute rounded cell; first vein on the basal fifth with a series of minute, close-set bristly hairs; third vein bare; antennæ small, rounded, with moderately long, subapical arista; mesopleura bare.

Type, *H. dubitatus* sp. nov.

This is a very remarkable form since it combines the characters of two subfamilies. The tibiæ bear isolated bristles near the basal third as in the Phorinæ, and the postantennal bristles are clearly proclinate as in the Metopininæ. In wing venation it resembles Nossibea Schmitz in the very small cell formed by the fork of the third vein, and there is also a trace of the bristly hairs at the base of the first vein; in Nossibea these extend the entire length of the vein and the third vein is also bristly. In many characters it resembles Gymnoselia Schmitz, particularly the tibial bristling and venation. The costa is very short,

its bristles absent, except basally, and the first vein is comparatively very long. In Gymnoselia the costa is entirely bare and the postantennal bristles are reclinate as in other genera of the subfamily Phorinæ.

Although there is only a single specimen, the essential characters are clearly to be seen, and they preclude placing it in any described living genus.

Hypoceridites dubitatus spec. nov.

♀. Length 1.5 mm. Apparently more or less uniformly brownish, darker above on the head, thorax and abdomen; wings hyaline, the venation brown. Front quadrate or slightly higher than wide, with fourteen bristles; one pair of small, closely approximate, proclinate postantennal bristles; antial bristle large, directed laterally and more or less upwards, much nearer to the median line and far below the lowest lateral bristle, which is near the eye and directed laterally with an upward curve; preocellar row of four equidistant bristles set very high up on the front in a straight transverse line. Front with a quite distinct median impressed line. Antennæ small. Palpi not clearly visible, furnished with bristles apically; proboscis small. Postocular cilia not enlarged; cheek with only a very weak downwardly directed bristle. Thorax short, very convex above. One pair of weak dorsocentral bristles and four nearly equal, slender and rather weak, but long, scutellar bristles. Abdomen with six complete tergites, the second and sixth longer than the others. Legs rather short, but not stout, the hind femora not much thickened; front tarsi thickened, the first joint twice as long as wide; second and third joints hardly one-half longer than thick; fourth and fifth growing more slender, the first joint two-thirds as wide as the tibia. Front tibia with a well developed, but not large external bristle just before the middle; middle tibia with a pair, one dorsal and the other anterior, just before the middle and a weak anterior one at the tip; hind tibia with a single anterodorsal bristle before the middle and a very weak one at the tip, in addition to one long and one very short apical spur. Costa scarcely one-third as long as the wing (37:12); its first section fully four times as long as the second (8:2) the second section about twice as thick as the first; cilia of costa very minute at the base and completely absent beyond the middle. First vein with very minute, but distinct bristly hairs on its basal fifth; running parallel with the costa and widely separated from it, then turning obliquely forward to its tip; third vein very close to the first at its base, forked at the extreme tip, which is a little

beyond the tip of the costa, to form a minute circular cell; fourth vein feebly curved, others not visible.

Type, No. 8120, M.C.Z.

Protophorites gen. nov.

Legs without bristles, but apparently the middle and hind tibiæ with two or three hair seams dorsally. Front without bristles below, except for a single pair of reclinate postantennal bristles; the margin of the vertex with a series of eight erect, rather small bristles and below these with a few irregularly dispersed smaller bristles which are, however, much larger than the scattered hairs frequently seen in various genera; front below the ocelli punctate; bare, except for the postantennals. Mesopleura strongly hairy above, with one very long backwardly directed bristle. Scutellum with a fringe of eight marginal bristles. Third vein forked, bristly for its entire length.

Type, *P. fimbriatus* sp. nov.

This is a very peculiar type, and I am not able to place it with satisfaction among the known genera of the family. The bristly third vein is a character seen only in several of the more primitive Phorinæ and in the Aenigmatiinæ. The bristling of the front is very unusual. I cannot be absolutely sure of the presence of the postantennal bristles on account of a flaw in the amber, but am quite positive that a reclinate bristle is present on one side. The presence of eight scutellar bristles is also wholly unexpected. In the general bristling of the front there is a resemblance to Platyphora, as well as in the bare middle and hind legs and bristly third vein; as well as the broad thorax. One may probably regard Protophorites as possibly related to some form ancestral to the Aenigmatiinæ, although, if we disregard the bristling of the front, it is very much like Megaselia in habitus and many structural details.

Protophorites fimbriatus spec. nov.

♀. Length 2.5 mm. Apparently entirely black or very dark and showing an aeneous or bronzed reflection on the body and legs. Front visible only in oblique vertical view, but seemingly as high or higher than wide; bristling as described in the generic diagnosis; ocelli rather small, in a nearly equilateral triangle, no evidence of any median frontal groove; post-ocular cilia moderate; cheeks each with two or three downwardly directed bristles of moderate size and a series of four ex-

tending toward the antennæ, the latter as strong as the others but directed upwards. Antennæ small, rounded, arista about reaching the vertex; palpi small, pale in color, bare, except for a few very small, almost minute bristles at the extreme tip. Thorax nearly as long as wide, strongly convex on the mesonotum. Scutellum very wide and short, more than three times as wide as long, its eight marginal bristles all short, but very stout, about equidistant along the edge; bristles along the sides of the mesonotum short, no dorsocentral bristle (or else it is outwardly displaced, as there is a bristle external to its usual position, very close to the hind edge of the mesonotum). Propleura with a stout bristle at the upper hind angle. Mesopleura hairy over its entire upper third with a long stout backwardly directed bristle on the hind margin and several short bristly hairs just above it. Legs moderately stout, especially the front pair; front tarsi clearly thickened, but the metatarsus not lengthened, narrower than the tibia and nearly twice as long as wide, third and fourth joints but little longer than wide. Six complete abdominal tergites, the second not lengthened, third and fourth shorter than the others, fourth and fifth with a fringe of stout but very short bristles along the posterior margin at each side; otherwise bare, except for the sixth tergite which is sparsely hairly with some longer bristly hairs at tip, sixth sternite also margined with a series of long, stout bristly hairs. Costa extending to about the middle of the wing, with very short closely placed bristles; first section of costa nearly three times as long as the other two together, second twice as long as the third (60:15:7.5); light veins not visible in the plane of the wing; fourth vein apparently moderately curved at the base and straight beyond.

♂. Similar to the female, with the front tarsi swollen in the same way. Antennæ larger, clearly elongate and bluntly pointed at tip; the arista dorsal, arising very distinctly before the tip. Abdomen without apical bristles on the tergites; hypopygium expanded in the specimen, apparently without conspicuous bristles, although its details are obscure.

Type ♀, No. 8121, M.C.Z.; male, allotype, No. 8122.

Protoplatyphora gen. nov.

♂. Very similar to Ænigmatias (*Platyphora*), but differing in several respects, which indicate that it is less specialized than the living genus Ænigmatias. Body broad and flattened above; the head broad, its posterior surface concave and closely fitting to the thorax;

thorax about as broad as long; abdomen short, tapering, the second and sixth segments noticeably lengthened; legs short and stout; all tibiæ without bristles or spines before apex; wing venation as in Ænigmatias. Front broad, minutely hairy, with two small, but very distinct, reclinate postantennal bristles and six rather short bristles along the edge of the vertex; palpi small, bristly; antennæ with subdorsal arista. Mesonotum without dorsocentral bristles, but with a pair of strong bristles at the hind margin near the side of the scutellum. Four long scutellar bristles arranged as an approximate pair near each side. Upper surface of mesopleura hairy, separated from the lower smooth portion by a very indistinct ridge. Front tibia two-thirds as long as the femur, their tarsi much thickened, the metatarsi not elongated. Wings ample; third vein forked near the apex, hairy for its entire length; costa thicker toward tip.

♀. Unknown.

Type. *P. tertiaria* sp. nov.

The discovery of this insect in Baltic Amber is extremely interesting, as it is obviously very similar to existing species which are myrmecophiles living, so far as is known, with certain species of Formica. The females of the living genus are apterous and one may surmise that in all probability those of the present form were also destitute of wings, and that the species was at that time already an obligatory myrmecophile. Protoplatyphora, moreover, appears to be ancestral to Ænigmatias, which is now restricted so far as is known to the Holarctic Region. This is shown particularly in the form of the front legs in the male, which approach clearly those of Ænigmatias. In the latter the tibia is greatly shortened, the metatarsus much lengthened, and the whole tarsus greatly thickened. In Protoplatyphora both these characters are evident, but not in such a high degree. Also the scutellum still retains the bristles characteristic of Phoridæ in general, although these are entirely lost in Ænigmatias. The loss of bristles on the front has progressed equally far in both genera, and the minute bristles along the third vein are retained in both.

Protoplatyphora appears thus as a remarkable link in structural evolution, and the discovery of the female will be awaited with great interest.

Protoplatyphora tertiaria spec. nov.

(Fig. 6)

♂. Length 1.8 mm. Antennæ rounded in dorsal and clearly pyriform in lateral view; arista practically bare; front broad, sparsely

clothed with small bristly hairs, a pair of larger ones representing the supraantennal bristles; ocelli in a small, flattened triangle; eyes large, strongly narrowing the front below; postocular cilia lengthened below, the cheeks each with five rather large bristles extending along the oval margin at each side; proboscis small; palpi small, slender, with three or four moderate bristles at the tip and a few much smaller ones before tip. Scutellum broad, but little narrowed at the sides, its

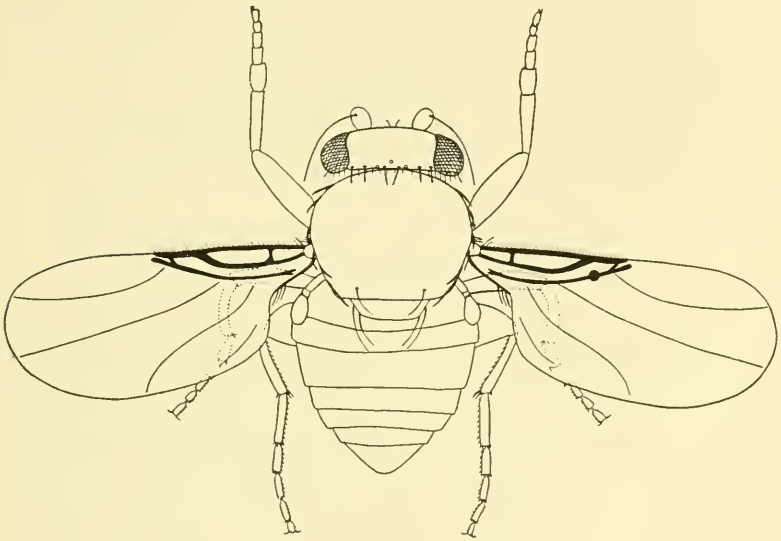

Fig. 6. *Protoplatyphora tertiaria*, gen. et sp. nov., dorsal view drawn mainly from the type, but reconstructed in certain details.

bristles rather strong, of equal length. Pleuræ shining, bare except for the patch of bristly hairs on the mesopleura above; with a fringe of minute bristles and one strong bristle along the edge of the propleura; abdomen without bristles at the side of the second tergite; sixth tergite suddenly narrowed, as long as the two preceding tergites together. Hind legs stout, the others only moderately so. Front tibiæ without spurs, these replaced by a few very small bristles; about two-thirds as long as their femora and fully three times as long as the metatarsus which is less than twice as long as wide; second, third and fourth joints successively smaller, each a little longer than wide.

Middle tibiæ with two rather distinct longitudinal lines of palisade hairs and two moderately long apical spurs. Hind tibiæ with several irregular lines of similar hairs and two rather weak spurs, their metatarsi long and spiny beneath. Costa reaching to the middle of the wing, with minute, closely placed bristles, noticeably, but not greatly thickened beyond the first vein which is also widened at tip; first section of costa fully twice as long as the second; third three-fifths as long as the second (12:5:3); third vein not noticeably thickened; fourth and fifth veins gently curved; others not clearly to be seen in the amber. Color apparently dark, with the legs perhaps paler especially the front ones; wings hyaline.

Type, No. 8123, M.C.Z. and six paratypes (Nos. 8124 to 8129). The several specimens vary in size, from 1.7 to nearly 3 mm., but there is no reason to believe that more than one species is represented in the series.

Megaselia uncifera spec. nov.

(Fig. 7)

♀. Length 2.0–2.2 mm. Apparently dark brown, with the upper side darker and the legs yellowish; antennæ and palpi pale yellow; wings hyaline, the venation dark brown. Frontal bristles large and strong; four postantennals, the lower pair not much smaller than the upper pair; antial bristle below the lowest lateral bristle and well removed from the eye; preocellar row of four equidistant bristles, the lateral one next to the eye, the median pair set lower than the lateral ones; postocular cilia not very long; cheek with a short, weak, downwardly directed bristle. Antennæ small, rounded, with a very long, pubescent arista fully twice as long as the front; palpi small, bristly, but the bristles rather thin. Proboscis as long as the eye, fleshy. Mesonotum strongly convex; one pair of dorsocentral bristles; scutellum small, convex, rounded-triangular with four long bristles placed in a row across the disk, far in front of the posterior margin. Mesopleura entirely bare. Abdomen with six tergites, the last, however, short, narrow and rounded behind. Apex of abdomen of the usual form with the pair of palpus-like bristly appendages above; below with a very slender, delicate spoon-shaped rod, curved upward at its tip and sharply pointed. This is very minute, no longer than one of the frontal bristles. Legs rather short and stout, the front tarsi thicker than usual, but not actually swollen or flattened. Hind tibiæ with no evident bristles along the dorsal edge. Wing narrow, more

or less parallel-sided; costa extending about to the middle (33:68). Costa swollen, the swelling increasing gradually from the basal third to the end of the second vein when it suddenly decreases; in the second section it is about four times the normal thickness, and on the third section about twice; costal cilia very short and closely placed at the base, gradually longer toward the apex until those on the apical section are of moderate length. First section of costa much longer than the other two together (17:11); second section slightly longer than the third (6:5); fork of third vein acute, the second vein entering the

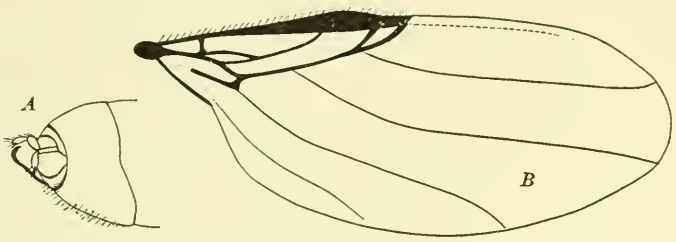

Fig. 7. *Megaselia uncifera* sp. nov., *A*, apex of abdomen; *B*, wing.

costa very obliquely, but forming a large and not very narrow cell. Fourth vein feebly curved, almost straight beyond the middle; fifth curved before the middle, straight apically; sixth sinuate; seventh almost straight.

Type, No. 8130, M.C.Z. and two paratype females (Nos. 8131, 8132).

This is a very well marked species on account of the swollen costa and the unusual position of the median scutellar bristles, which are inserted on the disk instead of on the posterior margin. This condition is not unique, as it occurs in at least one North American species, *M. brunnipes* Malloch. The peculiar chitinous structure at the apex of the abdomen is evidently associated with oviposition, and I strongly suspect that the species was parasitic. There is no question as to the sex of the specimens, as the paired cercus-like structures characteristic of the female are clearly visible in all three.

Megaselia veterana spec. nov.

♀. Length 2.6 mm. Apparently mainly dark colored, with at least the palpi, front legs and apical parts of the others lighter; wings

hyaline, with dark veins. Frontal bristles long and stout; four postantennals, those of the lower pair nearly as long as the upper ones. Antennæ small, oval, with a long, almost bare arista; palpi narrow, with moderately long bristles at apex. Postocular cilia long; two slender, downwardly directed bristles on each cheek and a series of four small bristles above the oral margin extending upwards toward the antenna. Proboscis fleshy, extending forward as far as the apex of the palpi. Mesonotum very strongly convex; a single pair of extremely long and stout dorsocentral bristles. Scutellum with four very large, equal marginal bristles, the median ones much farther from one another than from the adjacent lateral bristle. Mesopleura entirely bare above. Abdominal tergites of about equal length, the second one without bristles at the sides. Apex of abdomen with a few minute bristles; terminalia simple. Wings rather broad; costa not extending quite to the middle (30:65), its fringe of bristles extremely short and dense; first section about one-half longer than the second and third together; third section three-fifths the length of the second (13:5:3); humeral cross vein unusually long, the first vein widely separated from the costa at its base; apices of first and second veins parallel; last section of third vein curving upwards to the costa; fourth vein very feebly and evenly curved; fifth vein slightly sinuous on its apical half. Legs including all tarsi, slender; tibial spurs long; hind tibiæ showing a distinct hair-seam which curves forward and becomes obsolete near the base; anterior to the seam on the apical third of the tibia with an area formed by transverse rows of minute comb-like bristles.

Type, No. 8133, M.C.Z. Also two paratype females (Nos. 8134, 8135; both imbedded in the same block), one in particularly good condition, except that it does not show the wings. In addition there are four other females and two males (Nos. 8136 to 8141) which are mainly smaller (♀ 1.7–2.7 mm.; ♂ 1.4–1.5 mm.) but are most surely the same species in spite of the great variation in size.

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NEW GENERA AND SPECIES OF NEUROPTEROID INSECTS

BY NATHAN BANKS

WITH NINE PLATES

CAMBRIDGE, MASS., U.S.A.
PRINTED FOR THE MUSEUM
SEPTEMBER, 1939

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No. 7.—*New Genera and Species of Neuropteroid Insects*

By Nathan Banks

The following pages contain descriptions of various new Neuropteroid insects that have come to the Museum in recent years. They are from various sources, but all from the Old World. Altogether there are descriptions of seventy-five new species and ten new genera, and redescriptions of a few old species.

PSOCIDAE

Caecilius morosus spec. nov.

Head and thorax dark brown to black, shining, sometimes a small pale spot each side of ocelli; antennae black, densely short-haired, palpi white; eyes of male about a diameter apart; abdomen brown; legs whitish, tarsi darker, at least on tip.

In the female, with a broad dark streak from base to tip, leaving most of space behind medius clear, and also much above radial sector pale; the stigma not yellowish, but whitish, with a dark mark along middle of hind part connecting to dark streak; in the male the dark streak usually spreads over the entire wing, sometimes a little pale each side, stigma infuscate, but darker behind; veins mostly brown.

Hind wing fumose, veins dark, in some females the outer costal part is paler than elsewhere.

The stigma is slender, broadly rounded behind, widest a little beyond middle; forks of radial sector much shorter than the pedicel; union of radial sector and medius as long as base of radial sector (in females), in males often shorter; areola postica small, like *C. muggenburgi*.

Length 4.5 mm.

From Rocky Scrub, McIlwraith Range, Cape York, Queensland, Australia, 23–29 June (Darlington) Type M.C.Z. no. 21774.

It is in the group of *C. muggenburgi;* head shaped much as in that species, the same strong V-like emargination to vertex, the nasus perhaps not as swollen. The shining black head and thorax, black antennae, and shape of stigma will separate it.

Caecilius flavicosta spec. nov.

(Fig. 21)

Head pale fulvous, with short appressed hair; antennae pale, also with short hair; thorax yellowish above, brown on each side in front

of wings, clothed with very short hair; abdomen and legs pale. Fore wings yellow along front, the costa and subcosta and stigma all clear yellow, also behind the second anal and the hind marginal vein are clear yellow, between is a broad brown streak from base to tip leaving three clear spaces in front and several behind between the ends of veins, the areola postica all pale, between anal veins are two dark spots and an almost white spot between. The middle dark streak has an extension to the stigma and along each of the outer veins, and occupying most of the marginal cells. Hind wings faintly fumose, outer costal part clear. The fore wing has a long stigma, not quite angulate behind; the forks of radial sector rather shorter than pedicel, the union of medius and radial sector is very short; the areola postica is semicircular and rather small.

Length 2.5 mm.

From Lankelly Creek, McIlwraith Range, Cape York, Queensland, Australia 7 June (Darlington). Type M.C.Z. no. 21773. *C. marcidus* of the Philippines has the costa and subcosta jet black to the stigma, and the dark streak is narrower than in *C. flavicosta.*

Hemicaecilius medialis spec. nov.

(Fig. 1)

Head whitish, with moderately long scattered hairs; eyes of male large, hardly their long diameter apart; ocelli very close together; antennae pale, with many long hairs; thorax pale, with a few long hairs; abdomen dark above and below toward tip; legs pale, unmarked.

Wings hyaline, veins pale, except in fore wing the radial sector beyond separation from medius is dark brown, and here there is a brown streak through the middle of the apical half of wing, somewhat widened at tip, but nowhere reaching to the medius. Veins sparsely long haired, on front margin the hair dense and short, on posterior margin longer and fewer hairs.

Fore wing moderately long and slender; stigma very slender, broadly rounded behind; areola postica moderately high, about two and a half times as long as high, almost evenly rounded above; forks of radial sector as long as pedicel, union of radial sector and medius fully equal to base of radial sector.

Length 3.2 mm.

From National Park, McPherson Range, Queensland, Australia, 13 March 3–4000 ft. (Darlington). Type M.C.Z. no. 21771.

ZELANDOPSOCUS SINUOSUS spec. nov.

(Fig. 12)

Head black, with some short hairs and much longer erect bristles, head of female wide across top, eyes small, three (or more) diameters apart; antennae yellowish brown, with many very long whorled hairs; thorax black, also hairy and bristly; abdomen dark; legs pale, tips of tarsi dark.

Wings hyaline, veins brownish; stigma dark along posterior and outer part, very hairy; a dark spot at nodus. Stigma elongate, broadly rounded behind; radial sector beyond separation extremely sinuous, the forks about as long as pedicel; medius much curved; areola postica high, sloping on outer side, union of radial sector and medius very short; hairs on veins of fore wing extremely long, in some cases as long as the adjoining cell, and placed in two rows so that the veins appear knotted.

Length 3.8 mm.

From Mt. Lofty Range, South Australia, August (Darlington). Type M.C.Z. no. 21772.

In one wing there is a short spur of a vein from each side of the bend of the radial sector, and also from one side near the top of the areola postica; in the other wing these spurs are complete to form two cells. This is hardly a true *Zelandopsocus*, but the venation is too sinuous for *Philotarsus;* except for the markings it is similar to a specimen of *Z. formosellus* Tillyard.

PERLIDAE

PARAGNETINA INSIGNIS spec. nov.

(Fig. 79)

Body black above and below; head with a broad, transverse, reddish spot covering the ocellar region, and sometimes reaching to the eyes, and usually including the lateral tubercles; antennae, palpi, legs, cerci dark brown to almost black; wings dark brown, veins nearly black, in some specimens there are pale areas in the middle of many cells behind the radial sector over the rest of the wing, in both wings.

Ocelli large, as near to eyes as to each other; lateral tubercles oblique, the outer end being close to the eye; pronotum one and one half times

as broad as long, a little narrowed behind, the anterior angles sharp, disc not very rugose. In the fore wings about five or six cross-veins beyond subcosta, usually three branches to the radial sector beyond the anastomosis; cross-vein from radius to sector very oblique and continued so in base of the branch; second anal vein very sinuous.

In the hind wing the stalk of the median cell longer than width of the cell, second anal vein with four or five branches, in one specimen with several cross-veins. In male with fifth dorsal segment extended behind, broadly rounded, on seventh tergite a broad median black area, margined laterally and posteriorly, and divided behind; on eighth tergite a similar broad, median black area, and this is minutely granular; the processes are high, the basal part broad, the apical part moderately elongate, and within is a large pad or button.

Length of fore wing 25 to 27 mm.

Several males, all taken at Pingloo, Kwangsi, China in May 1933 by Gaines Lui. Type M.C.Z. no. 23421. Related to *P. pieli* but the apical part of the processes is longer, the fifth segment extended back farther, and the areas on seventh and eighth segments different. It is very much darker, and in *P. pieli* the head is much paler, with the ocellar area dark.

Togoperla sinensis spec. nov.

(Figs. 75, 81)

In general similar to *T. perpicta.* The ocellar area is black, but less black in front of ocelli than in *perpicta;* antennae brown, often yellowish on basal part behind, basal joint and the palpi black. Pro- and mesonotum black, metanotum sometimes paler on sides. Legs with the black band at base and tip of femora and tibiae as in *perpicta.* Abdomen pale toward base, darker near tip; venter mostly pale, darker at tip, cerci pale yellow.

Wings brown (as in *perpicta*), costal area yellow, subcostal area generally darker than rest of wing (as in *tricolor*).

Head with ocelli and tubercles, and the pronotum as in *perpicta.* Venation also about same, in hind wings often two cross-veins (instead of the usual one).

Male genitalia have the fifth segment about as in *perpicta,* but behind this are only the normal short hairs, and the apical part of process is much shorter than in *perpicta,* and the buttons on inner side of processes are very large, pitted much like *T. valvulata.* In female the

large elongate ventral plate is truncate and very shallowly excavate at tip (not the deep notch of *perpicta* and *tricolor*).

Length of fore wing 22 to 25 mm.

Several specimens from Yim Na San, Kwantung, China, 11 to 16 June (Gressitt). Type M.C.Z. no. 23419.

Togoperla klapaleki spec. nov.

(Fig. 76)

Similar in appearance and structure to *perpicta* and *sinensis*. The legs with the basal and apical black bands on femora and tibiae as in those species. The head, however, has a broad yellow stripe between the eyes and the central dark mark; pronotum and most of meso- and metanotum black; abdomen more brownish than allied species; cerci pale yellow. Wings hardly as dark brown as the other species, costal area yellow.

Venation about the same, both specimens have three cross-veins instead of one) in branches of anal in one hind wing. The ventral plate of female, instead of being convex on sides, is plainly concave, and much narrowed to the tip, where it is deeply notched.

Length of fore wing 27 to 31 mm.

Two females from Yim Na San, Kwantung, China, 11 and 14 June (Gressitt). Type M.C.Z. no. 23420.

The three species of Togoperla from southern China, all marked the same on wings, legs, and body, can be separated as follows:

Males

1. Long hair in middle behind tip of the fifth dorsal segment; apical part of the processes long ..... *perpicta*
   Only short hair behind the fifth segment; apical part of processes much shorter ..... *sinensis*

Females

1. Ventral plate with the sides concave, much narrowed to notched tip ..... *klapaleki*
   Ventral plate with convex sides 2
2. Ventral plate with apical notch ..... *perpicta*
   Ventral plate slightly, broadly emarginate ..... *sinensis*

Key to the Genera of Oriental Neoperlinae [1]

1. Third joint of maxillary palpi straight; head very broad behind; lateral tubercles placed high, the upper edge always higher than the lower edge of ocelli, latter about two or more diameters apart; in hind wings the median cell is usually longer than the pedicel 2
   Third joint of maxillary palpi more or less curved, usually much so near the base; head not especially broad behind; lateral tubercles usually placed below the lower edge of ocelli; in hind wings the median cell is usually as short or shorter than its pedicel 4
2. Males with the seventh ventral segment with a rounded elevated area, densely hairy, female with an extremely large ventral plate, covering the next segment ..... *Etrocorema*
   Male and female not as above 3
3. Male appendages simple, no spine at inner tip ..... *Tetropina*
   Male appendages with a long spine at tip of each ..... *Neoperlops*
4. Cubital fork short, ending much before the end of the cubito-median cell; lateral tubercles situate low, near the lower end of the eye... *Phanoperla*
   Cubital fork running out about to end of the cubito-median cell; lateral tubercles usually higher up 5
5. Head long, space from ocelli to front margin equal to width between eyes; eyes elongate, but little arched; ocelli small, about two diameters apart, and twice as far from the eyes ..... *Oodeia*
   Head not so elongate 6
6. Eyes scarcely arched; ocelli about three diameters apart, much further from the eyes; head and thorax, and usually wings, almost black . *Ochthopetina*
   Eyes well arched and prominent, ocelli usually closer to each other and larger; rarely more than partly black ..... *Neoperla*

Neoperlops gen. nov.

In general resembling Neoperla, but the head is broader behind; the lateral tubercles elongate and placed about as high as the ocelli; the third joint of the maxillary palpi is straight (instead of curved or twisted in Neoperla). In the hind wings the median cell is usually longer than its stem; all the species are large.

Type *gressitti* spec. nov.

Neoperla angulata Walker from Ceylon probably also belongs to this group, the specimens that Hagen so identified will go here. The

[1] *Macroplax* is the same as *Etrocorema*, and *Javanita* and *Formosita* I consider as synonyms of *Ochthopetina*.

lateral tubercles are, however, more oblique. The male genitalia are similar to *N. gressitti*, but the seventh tergite is somewhat prolonged behind, and on the eighth is a median ridge, the basal part of the processes is shorter and broader than in *gressitti*, but the apical spine is fully as long. There is no projecting ventral plate in the female.

Neoperlops gressitti spec. nov.

(Figs. 78, 82, 84)

Head pale, a triangular brown mark in the ocellar area, and a smaller one in middle near lower margin; palpi brown; basal and one or two other joints of antennae pale, beyond brown; ocelli from one and a half to fully two diameters apart; lateral tubercles almost longitudinal, more than three times as long as broad and quite close to ocelli. Pronotum pale, more or less brown in disc and darkest at median groove, broader than long, and plainly narrowed behind, rest of thorax pale, but often dark on the mesothoracic humps. Abdomen pale on basal part, dark toward tip in female; cerci pale; venter partly brownish in female, in male yellow; sternum yellowish; legs pale yellowish, tips of femora and tibiae black in male, in female all tibiae are more or less brown, especially above.

Wings faintly yellowish hyaline, veins brown, but costal area, and often the radius, yellow; six or seven cross-veins beyond the subcosta; radial sector arises well toward base, two branches beyond the anastomosis. In hind wing the median cell is usually longer than the stem, usually one or two cross-veins among anals.

In the male there is a patch of spicules on the seventh tergite near tip, which is here a little produced backward, also spicules at base of the eighth on each side of the notch; processes are slender, and each with a long slender spine at tip.

In the female the ventral plate is indicated by a small median lobe, with a notch each side of it.

Length of fore wings, ♂ 23 to 26 mm., ♀ 31 to 32 mm.

Two pairs from Yim Na San, Kwantung, China, 11 to 12 June, and Hong San, Kiangsi, 22 to 26 June (Gressitt coll.). Type M.C.Z. no. 23422.

Neoperlops obscuripennis spec. nov.

(Fig. 83)

Head dull yellowish, a large dark mark in ocellar area and reaching broadly forward; palpi brown; basal joints of antennae pale, beyond

brown; ocelli (♀) full three diameters apart, but somewhat farther from the eyes; lateral tubercles situate as in *N. gressitti*, and of same shape. Pronotum brown, broader than long, narrowed behind; rest of notum dark in middle, paler on sides; abdomen yellowish brown on basal part, brown toward tip; cerci brown; sternum yellowish; venter yellowish on basal part, beyond brown. Legs mostly brown, sometimes darker at tips of femora and tibiae, femora usually dull yellow on sides, and the hind femora on the basal half above.

Wings evenly pale brown, the costal area not paler, veins darker brown; venation much as in *N. gressitti*, but usually three branches to radial sector beyond the anastomosis. The ventral plate is indicated by a swollen, elliptical dark area on the middle of the hind margin of the seventh segment.

Length of fore wing, 22 to 25 mm.

Four females from Yim Na San, Kwantung, China, 12 to 16 June (Gressitt). Type M.C.Z. no. 23423.

Neoperla parva spec. nov.

(Fig. 29)

Pale brownish, basal two thirds of abdomen more yellow; antennae (except base) brown; legs and cerci pale, tarsi darker. Fore wings faintly gray, veins brownish, costa, subcosta, and radius less distinctly; hind wings hyaline, with pale veins. Head moderately broad; eyes (from side) a little longer than high; ocelli moderately large, about one and a half diameters apart in male, in female about two diameters apart, in both nearly twice as far from the eyes; lateral boss oblique, about midway from eye to ocellus, or rather nearer latter.

Pronotum once and a third broader than long, but little narrowed behind, middle area rather narrow, sculpture moderately coarse.

Fore wings with about ten costals, two beyond end of the subcosta, radial sector usually with but one branch, usually but two or three (rarely four or five) median, and two or three cubital cross-veins; in hind wings the radial sector has but one branch, and the discal cell is about as long as its pedicel.

Male genitalia show from seventh segment a slight median projection followed across eighth by a median carina, ninth with a curved transverse raised streak each side and inner ends with some small spine-like hairs; anterior process long, slender and straight, lower process broad, short and rounded.

Length of fore wing 9 to 10 mm.

From Telang, Oct.; and Baram River, Sept., Borneo. Type M.C.Z. no. 22692

Neoperla moesta spec. nov.

(Fig. 30)

Head yellow brown to reddish brown; ocelli on black spot; antennae and palpi dark; pronotum brown or faintly reddish brown, usually darker on sides; abdomen pale, scarcely darker at tip; legs brown or yellowish brown, darkest on upper side of tibiae, tarsi dark, no distinct mark under knees; both wings evenly pale brown, except the costal area is faintly yellowish, but costa, subcosta, and radius are brown, as also the costal cross-veins, other veins also brown. Head moderately broad; ocelli nearly two diameters apart, fully as far from the eyes, lateral boss is transverse and nearer to eyes than to ocellus. Pronotum nearly twice as broad as long, much narrowed behind, front rounded, anterior corners about square, median area rather narrow, sculpture fairly coarse. In fore wings eight or nine costals, two beyond end of subcosta; radial sector usually two-branched, first from near anastomosis; six or seven median and five or six cubital cross-veins. In hind wings the radial sector is two-branched, and the discal cell a little longer than pedicel.

The male has a rather broad triangular process from the seventh segment, the tip rounded and with teeth below; on eighth segment there is a laterally delimited area, with the broad tip extending a little beyond the margin, there is a carina or row of teeth along the middle; the inner ends of the ninth segment are very plainly roughened; the anterior process is slender, slightly curved, but not sharp pointed, the lower process a broad lobe.

Fore wing 11 to 13 mm. long.

From Shimoga, Mysore, India, August (P. Susai Nathan coll.). Type M.C.Z. no. 22695.

What Klapalek calls *N. limosa* Hagen is somewhat similar, but the process of seventh segment is more slender and longer, and the ocelli are said to be nearer to eyes. Hagen's *N. limosa* is closely related to *N. minutissima* Endl., with similar genitalia. This species in some ways agrees with *N. tristis* Navas, but I have identified as *N. tristis* a smaller species, with paler wings, and the costal area plainly yellowish. This also has the ocelli much nearer to each other than to the eyes, and

the process from the seventh segment is very long, but more slender than Klapalek's figure for his *N. limosa*. Needham's figure of *N. indica* will fit none of these forms.

Neoperla (Oodeia?) centralis spec. nov.

(Fig. 32)

Pale yellowish, head slightly darker in middle, pronotum with a median dark stripe, which extends back on the mesonotum. Fore wings pale, costa, subcosta, and radius pale yellowish, also the costal cross-veins, radial sector, medius, and cubitus, the anastomosis and cross-veins brown, and sometimes slightly bordered with brown; hind wings pale, with pale veins. Antennae, palpi, legs, cerci all pale, but tarsi somewhat brown.

Head rather narrow and long; eyes (from side) much longer than high; ocelli moderately large, hardly one diameter apart, more than twice as far from the eyes; lateral boss rounded, smaller than ocellus, situate near beginning of lateral ridge, and thus much nearer to eye than to ocellus.

Pronotum about once and a half as broad as long, hardly narrowed behind, middle area moderately broad, sculpture rather coarse.

Fore wings with about fourteen costals, two or three beyond end of subcosta, cross-vein from radius to radial sector much before fork, radial sector with three branches, about seven median and five cubital cross-veins; in hind wings the discal cell about as long as its pedicel; radial sector with three branches.

In male the eighth segment shows a rather long, almost pointed triangular median projection; the anterior process is slender and pointed, almost evenly curved, the lower process is shorter, stouter and somewhat curved, the ninth segment has a small spot of short, stout bristles.

Fore wings 12 mm. long.

From Mt. Murud, Borneo, 23 Feb. (Mjoberg). Type M.C.Z. no. 22694.

The narrow head and elongate eyes place this near Oodeia. A female from North Borneo is larger, but marked the same, but the lateral boss is elliptical and fully as near ocellus as to eyes. Of the three Neoperla described by Navas in 1929 from Borneo, *N. nangina* by the head marks, shape of pronotum, and few costals is plainly *Tetropina larvata*. Both the others have ocelli wider apart than in the above species, and *T. lebangina* seems to agree quite well with *N. variegata* Klap.

Oodeia klapaleki spec. nov.

(Fig. 103)

In general very similar to the Malayan *O. dolichoptera*. Head pale, with the same black triangles, one over the ocelli with point forward, other on front margin with point upward, the points often meeting; ocelli larger than in *dolichoptera*, and scarcely more than their diameter apart; lateral tubercles transverse, much nearer ocellus than eye; pronotum about as in the other species, brown, narrowed behind, anterior corners prominent, and the two median ridges are distinctly separate throughout; rest of thorax and the abdomen yellowish; legs yellowish, the tibiae usually dark at base and more or less darkened above; cerci pale, darker toward tips.

Fore wings slightly infuscate, veins brown, but the costal area and veins pale yellowish; one or two cross-veins beyond the end of subcosta; radial sector with two or three branches beyond the anastomosis; in hind wing the median cell is about as long as the pedicel, and there are one or two cross-veins among the anals. The ventral plate of the female is only slightly swollen in the middle and with a moderately deep subtriangular emargination, which is much narrower than that of *dolichoptera*.

Length of fore wings 15 to 17 mm.

A number of females from Yim Na San, Kwantung, China, 11 to 17 June (Gressitt). Type M.C.Z. no. 23425.

Ochthopetina nigrifrons spec. nov.

(Fig. 73)

Head and pronotum black, sometimes the lower part of face paler, mesonotum dark, metanotum and abdomen yellow; legs pale on most of femora, tibia and tarsi dark; antennae pale on basal third, beyond dark, palpi dark, cerci pale. Wings evenly dark brown, veins darker, but costal area and the veins there yellowish, a whitish hyaline line in front of the median vein along the middle part of wing, in the hind wing this streak is nearer the radial sector and partly on the lower side of the discal cell.

Head rather broad; ocelli small, fully three diameters apart and not as near eyes as to each other, lateral boss small, rounded and not far from the beginning of the lateral face ridge, thus fully twice as near

to eye as to ocellus; pronotum broad, fully twice as broad in front as long, much narrowed behind, front rounded, anterior corners about square, median area very broad, sculpture not very coarse.

Fore wings with the subcosta very short, not nearly reaching to anastomosis, only one to three costal cross-veins, and beyond subcosta one or two; the anastomosis more basally placed than usual, so that the apical area is longer than normal, radial sector with one branch, five or six median and cubital cross-veins, cubital fork arises only a little before the first cubito-median cross-vein, but at an acute angle, and is as long as usual. In hind wing the radial sector with one or two branches, and the discal cell much shorter than its pedicel.

The male genitalia have the anterior process small, slender, and pointed, not as long as usual, the ninth segment has a small roughened area at inner ends, the seventh has a median lobe, broad, but very short.

Length of fore wing 8 to 10 mm.

From Ta Han, 23 June, Liamui, 2 Aug., and Dome Mt., 13 July, Hainan Island. Type M.C.Z. no. 22693.

Phanoperla nervosa spec. nov.

(Fig. 25)

Head and thorax brownish yellow; abdomen paler yellowish; antennae, palpi, legs, and cerci pale; tips of tarsi and cerci darker. Fore wings pale; costa, subcosta, and radius pale, other veins mostly brown, and many of them margined more or less distinctly with brown, especially at anastomosis and the median and cubital cross-veins; hind wings pale and with pale veins.

Head moderately narrow; ocelli rather small and close together, scarcely more than diameter apart, fully twice as far from the eyes. Lateral boss small, rounded and much nearer to lower eye than to ocellus. Pronotum nearly twice as broad as long, front convex, median groove very distinct and dark.

Fore wings with twelve to fourteen costals, two beyond end of subcosta, radial sector usually with three branches beyond anastomosis, four or five median cross-veins, and two from cubitus to sector, and two beyond end of cubital fork.

In hind wings two or three branches to radial sector, discal cell almost as long as its pedicel and its front margin plainly concave.

In male the forked processes are ivory white, and both branches

very broad and heavy, the lower one very short, the upper twice as long and almost pointed; inner margins of ninth segment roughened with many small teeth.

Fore wings 11 to 12 mm. long.

From Sarawak, Borneo. Type M.C.Z. no. 22690.

It differs from *P. hageni* (Neoperla) in having the tips of the processes longer and acute; *P. hageni* shown in Fig. 28.

Dyaperla gen. nov.

A Neoperla with three ocelli, the anterior one very small, but distinct and forming with the others a long isosceles triangle. Venation as in Phanoperla, the cubital fork short, and arising in a broad curve from near the first cubito-median cross-vein; lateral boss small and as far forward as in some Phanoperla; eyes not very large, and (from side) a little longer than high; in hind wings the discal cell is short. The male genitalia on the plan of Neoperla.

Dyaperla anomala spec. nov.

(Figs. 24, 26.)

Pale yellowish, also the appendages and wings, only extreme tips of tarsi darker, pronotum scarcely brownish, each ocellus surrounded by a black ring.

Head only moderately long, posterior ocelli as far from hind margin as in Phanoperla, small, fully two diameters apart, and much farther from eyes; anterior ocellus small, and nearly twice as far forward as the hind ocelli are apart; lateral boss down near the lateral face ridge. Pronotum about once and a third as broad as long, not much narrowed behind, anterior corners rounded, median smooth area very broad, lateral sculpture fairly coarse. Fore wings with eight or ten costals, one or two beyond end of subcosta, radial sector with one fork, rather far beyond anastomosis; five or six median cross-veins, two cubital cross-veins to cubital fork, and two or three beyond. In hind wings the discal cell is hardly one-half as long as its pedicel, about six cubital cross-veins, radial sector with one branch.

Male genitalia with no median projection on dorsal segments, the inner part of ninth broadly roughened by numerous erect brown tubercles, many of them in rows; the anterior process is fairly long,

pointed at tip, the lower short and rounded, the base of the processes extends toward each side, but is narrow throughout.

Length of fore wing ♂ 10.2 mm.; ♀ 12 mm.

From Mt. Dulit, Borneo, 3000 ft. (Mjoberg). Type M.C.Z. no. 22691.

Key to the Genera of Oriental Acroneurinae

1. Ocelli two 2
   Ocelli three 5
2. An extra cross-vein (or two) between the first and second anal veins in the fore-wings ..... *Atoperla*
   No such extra vein 3
3. Pronotum quadrangular, ninth sternite with a triangular corneus piece at tip; ocelli often as near or nearer to eyes than to each other .... *Gibosia*
   Pronotum somewhat six-sided, the lateral margin not bent down, ninth sternite with an elliptic button, ocelli much nearer to each other than to the eyes 4
4. Head back of eyes prolonged for a greater distance than length of eye, thus head longer than broad; metasternum with nearly parallel sutures ..... *Schistoperla*
   Head not prolonged back of eye nearly the length of an eye, thus head broader than long ..... *Kiotina*
5. Pronotum six-sided, the lateral margin not bent downward .. *Nipponiella*
   Pronotum quadrangular, the side margins bent down as usual 6
6. The male processes arise from above the cerci ..... *Claassenia*
   The male processes arise from between the cerci ..... *Acroneuria*

Atoperla chiangi spec. nov.

(Figs. 80, 85)

Head black around ocelli, in front paler, the tubercles pale; palpi and antennae brown, basal joint of latter black; ocelli about as near eyes as to each other; lateral tubercles large, about as near eyes as to ocelli.

Pronotum dark brown, shining, very rugose, much broader than long, anterior angles sharp, hind corners rounded, only a little narrower behind than in front; meso- and metanotum largely dark, but pale on sides; abdomen yellowish brown, darker at tip; cerci black; sternum yellowish, venter rather darker and much darker at tip; legs pale yellowish on fully basal half of femora, beyond black to tip of tarsi.

Wings evenly pale brown, veins darker, costal area yellow. In fore

wings radial sector arises well toward base, two branches beyond anastomosis, two cross-veins between first and second anals, three to four cross-veins beyond end of subcosta. In hind wings the median cell more than twice as long as its pedicel, about six cubital cross-veins; no cross-veins connecting anals.

The last ventral segment of the male shows a nearly circular button about its diameter from the hind margin; the processes are short and sharp-pointed, thorn-like, and wide apart.

Length of fore wing 13 to 14 mm.

Two males from Yim Na San, Kwantung, China, 14 June (Gressitt coll.).

Differs from the two other Chinese species in the shape of the genital processes, as well as in venational points and in color, especially color of legs. Type M.C.Z. no. 23424.

Kiotina resplendens spec. nov.

(Figs. 74, 77)

Deep black throughout and in many places iridescent, fore wings with violaceous reflections, the hind wings, seen from in front, are purplish; head shining, short and broad, with the two ocelli close to pronotum, these small about four diameters apart, and fully twice as far from the small and short eyes; lateral tubercles also close to pronotum, transverse, between the ocelli and eyes.

Pronotum nearly twice as broad as long, broadest behind middle, the lateral margins not depressed, so somewhat six-sided, a broad middle field, and the sides with strong rugae.

Fore-wings with a cross-vein between radius and radial sector near tip; radial sector with three or four branches beyond the anastomosis; often six cross-veins beyond end of subcosta; in hind wings the median cell is extremely long, the pedicel scarcely more than width of cell; second anal with various branches, and one or two cross-veins. In the female the ventral plate is large and broad, more than covering the next segment, its hind margin scarcely emarginate. In the male the ninth sternite shows a transverse, pale, nearly elliptical button, almost as near to base as to hind margin of the segment; the processes are fairly large, broad at base, and with a slender, straight tip, apparently continued on the outer margin.

Length of fore wing, ♂ 18 mm., ♀ 20 mm.

A male from Hong San, Kiansi, China, 26 June, and a female from

Yim Na San, Kwantung, 15 June, (both Gressitt coll.). Type M.C.Z. no. 23426 Related to *K. suzuki* Oko. from Japan, but that species is not so dark, nor iridescent, and the ventral plate is different.

Klapalek has recorded *K. violaris* Enderl. from Tonkin. I have a paratype of *violaris* from Java; the eighth ventral segment is simply broadly rounded, not a large plate like *resplendens*, the basal part of all femora is pale yellowish, the antennae pale on basal part, the head is not as broad as in *resplendens*, the pronotum longer.

MYRMELEONIDAE

Mossega Navas

This genus has been based on venational characters that are variable; in one of my original specimens of *M. indecisa* there are no connecting veinlets in the costal area, and when present are often only a few. However, this species, with *G. osmyloides* and a new species, differs from *Glenoleon* in having more slender legs, the basal tarsal joint more elongate, in the very broad costal area (very much broader than radial space) and in that the radial sector arises long before the cubital fork, there being three to five cross-veins between the radial sector and the cubitus before the cubital fork. In all three the wings are very delicate, and the veins very slender.

Mossega hyalina spec. nov.

Face brown, extending up above the antennae, vertex pale, a dark line across front and a faint line behind, and between are some faint marks; palpi pale; antennae brownish yellow, darkest at tip.

Pronotum pale, with median dark streak, but in the extreme fron, a median pale line, hairs on pronotum very long, lateral ones whitet median ones black; meso- and metanotum mostly brownish, with some small pale marks, pleura pale, with dark spot, some forming a line just below base of wings; abdomen brown above, paler below on basal half and also last segment, hair white.

Legs pale, clothed with mostly white hair, some dark bristles, dotted with dark, more distinctly dark at ends of tibiae and tarsal joints, front tarsi mostly dark; last tarsal joint about equal to apical, spurs not longer than basal joint.

Wings hyaline, unmarked, stigma indistinct; veins pale, slightly

marked with dark at ends of cross-veins, the first cross-vein beyond stigma margined with brown, also some at and near rhegma, the forkings of marginal veins, and a few spots along cubitus and cubital fork dark.

Hind wings unmarked, except a few very small, dark dots at outer forkings.

In fore wing costal area is very broad as in allied species, between radial sector and cubitus five cross-veins before cubital fork, three cross-veins before radial sector, nine branches to radial sector (in both wings) venation very similar to *M. indecisa*, but no connecting veinlets in costal area; hind wing but little longer than fore wing.

Length fore wing 19.5 mm., width 6 mm.

" hind wing 20 mm., width 4.5 mm.

From Coen, Cape York District, Queensland, Australia, May to June (Darlington). Type M.C.Z. 20243.

Cueta hugeli var. inciva var. nov.

In general similar to typical form, but distinct by a rather broad, black, median stripe on the face from at or near interantennal mark down to the mouth; when connected to interantennal mark there is left a pale median spot. It is a little larger than typical form, with the body marked the same; the wings are heavily marked and the pale streak each side of the white banksian line is very distinct. The male appendages are moderately short as in *hugeli*, densely clothed with black bristles. There are usually several of the cross-veins in front of cubital fork that are crossed.

From Coimbatore, South India, Nov. to Dec., and 16 Sept. (P. Susai Nathan). Type M. C. Z. no. 23231.

I have *C. hugeli* from Vizagapatan, Madras Province, India (Frazer).

Cueta facile spec. nov.

Head pale yellowish, an interantennal spot, forked below, truncate above; vertex with narrow median brown stripe, and two spots each side, front one extending toward eye; last joint of labial palpi brown outside; antennae pale yellowish, not annulate, tip above rather brownish. Pronotum almost as long as broad, with narrow median black line, and three or four almost connected dots each side, some dark hairs in middle, five or six long, curved white hairs each side; on mesonotum

the median dark stripe is divided, sides with some dark spots and streaks; pleura with two dark stripes, hair long and white.

Abdomen with dark venter, dorsum pale, with a median black stripe and a dark streak on side of each segment, apical segment (♀) wholly pale and very short. Legs pale, dotted with dark on upper and outer sides, some black hair on femora and tibiae above, and many bristles black, but rest of hair and some bristles on front and mid legs white, a brown mark on front coxa; spurs on front and mid legs about two-thirds of basal joint, on hind legs little more than one-half, basal tarsal joint plainly shorter than the apical.

Wings moderately slender, tips nearly acute; venation pale, scarcely at all marked, except the main longitudinal veins are spotted, the radius wholly pale, the radial cross-vein before stigma, and two beyond are dark, a dark vein at rhegma and small dot at end of cubital fork, these in both wings dark, as also a dark mark at base of stigma in hind wings, and in fore wings the forks in apical half of wing and a row of gradates above and one below the banksian line are black.

In fore wing eleven or twelve cross-veins before radial sector, ten branches of sector, anal with seven or eight branches to margin.

In hind wing ten or eleven cross-veins before radial sector, ten branches to sector, and five or six branches from anal to margin.

Length of fore wing 27mm., width 6.8mm.; length of hind wing 24mm., width 5.5mm.

From Coimbatore, S. India, Nov. to Dec. (P. Susai Nathan). Type, M.C.Z. no. 23230.

Gama irene spec. nov.

Of the general appearance of *G. mortifer*. Head pale, face unmarked, a dark band above antennae, sometimes with median pale spot, two black bands on vertex from eye to eye, behind the last are six dull black spots, two in middle close together, and two, well separated, each side; last joint of labial palpi partly dark, antennae brown, annulate with pale, basal joint pale, a dark spot in front. Pronotum dull black, with gray marks, a median line, and a broader stripe each side containing two dark spots; a few curved white hairs each side. Mesonotum dull black, with a pale, median stripe and some spots on sides; about opposite base of fore wings are two submedian transverse black spots; metanotum dark, a deep black, transverse mark each side near the middle; pleura dark above, pale below and with much long white hair. Legs spotted and banded with black, clothed with much white

hair, and some white and more black spines; spurs nearly equal to four joints.

Wings acute at tip, slightly concave on outer margin; veins pale, nearly white, much streaked with black, some veins wholly black and a few wholly pale, some outer cross-veins and forks margined with dark, a distinct dark spot at rhegma, streak or spot at end of anal, extending up to cubitus and back on anal; stigma brownish.

In hind wing venation less marked with black, a distinct dark spot at rhegma, stigma unmarked.

In fore wing are seven cross-veins before the radial fork, twelve branches to radial sector, thirteen branches of anal to margin, a cross vein from third anal to second. In hind wings twelve branches of radial sector, ten branches from anal vein to hind margin; the cubital fork is rather irregular. Poststigmal crossveins in both wings.

Length of fore wing 28mm.; width 7mm.; length of hind wing 26mm.; width 5.5 mm.

From Darjeeling district, India (Frazer), and Shimoga, Mysore district, India, 27 May (P. Susai Nathan). Type M. C. Z. No. 23229.

Formicaleon distinctus spec. nov.

Body pale yellowish, head with a brown inter-antennal mark extending a little below and above up to the vertex, here it contains a median pale spot; palpi pale; antennae with first few joints brown, beyond pale yellowish until near the tip which is brown; pronotum broadly pale brown in middle, divided by a pale median line, meso- and metanotum mostly pale brown, pleura wholly pale; abdomen pale, second segment mostly brown above, others broadly brown at tip with faint dark spot near base, last segment wholly dark above, pale below; legs pale, very faintly dotted on femora, tips of tibiae brown, and less distinctly on some tarsal joints, hair mostly white, but some black bristles, spurs equal four joints.

Wings hyaline, veins pale, longitudinal ones streaked with brown, many cross-veins wholly brown, others wholly pale, a series up from end of anal and curving somewhat backward is black and bordered with dark, brown spots at rhegma, at base of stigma, latter rather reddish; hind wings with a brown spot at base of the rosy stigma, and one at rhegma, veins marked much as in fore pair. Wings very broad toward tip, so that the rhegma is far from hind margin, the space behind cubitus in some places with six or seven rows of cells. Both

wings are plainly a little excavate on outer margin at end of the radius.

In fore wings the radial sector arises just a little beyond the cubital fork, six cross-veins before it, three cross-veins from anal to cubital fork, some connected, nine branches of radial sector, the cubital fork makes a wide angle with the cubitus (as in *tetragrammicus*, *annulatus*, etc.) In hind wing nine branches to radial sector, anal connected once to cubital fork, four or five rows of cells at widest part of postcubital area.

Length of fore wing, 37 mm., width, 11 mm.

Length of hind wing, 34 mm., width, 8.5 mm.

From Mullewa, West Australia, 18 Sept. (G. M. Allen). Type M.C.Z. no. 20215.

Its very broad, slightly emarginate wings, pale color, and banded abdomen recalls *F. annulatus* of South Europe. Its broad wings and second and third anal veins united for some distance puts it in the section of Hyloleon.

Formicaleon marginalis spec. nov.

Face dull yellowish, a large interantennal mark reaching up, with hardly a break, to vertex, latter with median brown stripe and a large brown spot each side near eye, vertex rather higher than usual; antennae dark annulate with pale; pronotum plainly broader than long, a broad, brown stripe each side, and a narrow outer stripe from furrow back, hair black, no long white on sides; mesonotum dark on sides; metanotum dark with a pale spot each side toward middle; pleura mostly dark, but some parts with pale borders.

Abdomen dark, a pale transverse spot before middle of second and third segments, hair above very short and dark, below longer and white. Legs pale, dotted and spotted with dark, a band near tip of femora; at basal section and at tip of tibia above are shining black spots, tips of tarsal joints dark, bristles black, some hair above pale. In all tibiae, but especially the front and mid pairs, the basal section is swollen above so that it bulges out from the rest of the joint more than in any other species known to me; spurs of front and mid legs more than equal first four joints, in hind legs equal to four joints.

Wings rather broad toward tip, not acute; in both pairs of the outer margin is fumose rather broadly. In fore wings the longitudinal veins are interrupted, with dark spots or streaks, many cross-vents wholly dark, a few wholly white in apical half. Many dark spots or clouds in

postcubital area, largest on end of anal, a fairly large one at rhegma, the outer row of cross-veins margined with dark, last three radial cross-veins, and some poststigmal ones also margined, some of the cross-veins in basal half of wing behind medius are more or less margined, stigma white, with dark spot each side, hair on veins rather short and very fine.

In hind wings venation mostly dark, a dark dot at rhegma, and at base of stigma, the fumose margin extends up around tip and nearly to stigma. In fore wings five cross-veins before radial sector, nine branches to radial sector, four between anal and cubital fork, thirteen branches from anal to margin, the radial sector arises just about as far forward as the cubital fork; second anal connected to third by a very short cross-vein, the cross-vein above arising nearly its length beyond the separation.

In hind wing nine branches of radial sector, one or two between anal and cubital fork, eight branches of anal to margin, postcubital area with mostly two series of cross-veins, except toward tip, the cubitus parallel with margin for most of distance, the greatest width about equal to space from medius to radius at first branch of radial sector. Poststigmal cross-veins in both pairs.

Length of forewing 22.5mm., width 5.9mm., length of hind wing. 22.5mm., width 5mm.

From Tenasserim, Burma. Type M. C. Z. no. 23228.

Formicaleon helene spec. nov.

Face pale, a brown band below antennae, large spot above, a band at front of vertex, and a row of spots behind; labial palpi dark at tip; pronotum brown, median pale spot in front part, a pale streak each side, its anterior end enlarged and containing a dark spot, hairs above all black, a few long, curved white ones each side; rest of notum mostly dark, but paler through middle; pleura with some dark spots, white hairs below; abdomen dark, obscurely marked with pale each side, white hair below, above with minute hair almost invisible.

Legs pale, spotted with brown, tip of hind femur brown, tibiae twice barred with brown, tips of tarsal joints dark; spines black, but some white on mid and hind femora below; hair mostly white, black above on front femur; spurs equal four joints; in male much very long, fine black hair on hind femora and tibiae, mostly on inner side below.

Wings moderately broad, tips not acute. In fore wings longitudinal

veins pale, interrupted with dark, cross-veins partly dark, some wholly dark; a small dark spot at rhegma, a faint brown spot at end of cubital fork, no forkings or cross-veins bordered, stigma scarcely dark within.

In hind wings the subcosta, radius, and cubitus interrupted with dark, other venation mostly pale.

In fore wings seven or eight cross-veins before radial sector, eleven branches to radial sector, five or six cross-veins from cubital fork to anal, eleven branches from anal to hind margin, second anal touches third at a point, the third forked, postcubital area at widest broader than rest of wings at that place.

In hind wing nine or ten branches of radial sector, anal ends before cubital fork, so no connection, five branches of anal to hind margin; postcubital area very narrow, the cubitus about parallel to hind margin, at widest not equal to space from cubital fork to radius, mostly divided by one row of cross-veins; poststigmal cross-veins in both wings.

Length of fore wing 29 mm., width 6mm., length of hind wing 29 mm., width 5.5mm.

From Tenasserim, Burma. Type M. C. Z. no. 23227.

Formicaleon marcida spec. nov.

Face pale, a black band below antennae, a dark band above containing a median pale spot, a row of connected spots across front of vertex, and the usual spots of *dirus* behind; antennae pale, narrowly annulate with dark; pronotum much broader than long, pale, a fairly broad submedian stripe each side, tapering behind, lower posterior sides nearly black, and between are a few dark shadings, short dark hair above, sides with long, curved white hairs; rest of notum mostly pale in middle, dark on sides, mesonotum with an intercalated line, scutelli with pale hind border, except dark dot in middle; pleura pale, with a few dark streaks, much long white hair.

Abdomen gray brown, with pale spots on the plan of *F. dirus*, venter pale, hair above short and dark, below but little longer, white. Legs pale, dotted and spotted with dark, fore femur darkened above and with black hair, mid and hind femora dark at tip and latter with a basal streak, tibia with side spots and with three elongate spots above, hair and bristles mostly white, some bristles on tibia black, outer side of hind femur and tibia of male with long white hairs, inner side of hind femur with long black hairs, spurs equal to about four joints.

Wings with veins much as in *F. dirus*, a spot at rhegma and at end of cubital fork, some outer cross-veins and marginal forkings dark, stigma pale, dark within, the largest space of wholly white veins is obliquely below the stigma, the patches elsewhere are small; in hind wings few marks, the rhegma and some outer forkings brown.

In fore wings eight cross-veins before radial sector, twelve branches to radial sector, six between anal and cubital fork, eight or nine branches of anal to margin, second anal touches third at one point, the cross-vein beyond the separation; postcubital area at broadest more than one-half of wing at that point. In hind wing eleven branches of radial sector, no cross-vein from anal to cubital fork, the anal ending before forking of cubitus, four branches from anal to margin, postcubital area very narrow, the cubitus parallel to the margin, hardly one and a-half times as wide as costal area. Poststigmal cross-veins in both wings.

Length of fore wing 28.3mm., width 6mm., length of hind wing 29mm., width 4.7mm.

From Nedungatu, Tanjore, S. India, 4 to 14 Febr. (P. Susai Nathan).

Type M. C. Z. no. 23226.

Distoleon alicia spec. nov.

Face pale, a dark mark under each antenna, a large spot above vertex with a margined transverse scar each side, behind is a pale median line, and dark each side, antennae brown, very narrowly annulate; labial palpi with dark tips. Pronotum dark, a pale median line, dark hair, no white ones on side; mesonotum dark, pale in middle; metanotum dark, a pale spot each side and at tip of scutellum; pleura dark above, paler below, with some white hair. Abdomen dark, faintly pale each side above, very short, black hair.

Legs pale, much dotted with dark, tips of tibiae and tarsal joints dark, spurs equal four joints in front legs, three or more in hind pair, most of hair black, some white below, spines black.

Wings moderately broad, tips not acute; veins pale, longitudinal ones interrupted with dark, others dotted with dark, a spot at rhegma, and there and beyond some cross-veins wholly dark, last two radial cross-veins and some poststigmal cross-veins also dark, a faint spot at end of anal vein, stigma large, white, brown within.

In hind wings longitudinal veins mostly streaked with dark, and others dotted with dark, but some in apical half wholly dark, stigma

brown, small. In fore wings the second anal unites with the third for such a distance that the second anal appears forked; eight or nine cross-veins before the radial sector, twelve branches to radial sector, four cross-veins between anal and cubital fork, postcubital space broad, at widest one-half of wing width at that place.

In hind wings twelve branches to radial sector, no cross-veins from anal to cubital fork, eight branches of anal to hind margin, postcubital area moderately broad, at broadest equal to space from cubital fork to radius, mostly with two rows of cross-veins. Poststigmal cross-veins in all wings.

Length of fore wing 29mm., width 7mm., length of hind wing 29mm., width 5.8mm.

From Tenasserim, Burma. Type M. C. Z. no. 23224.

Distoleon rhodocerus Navas

Face pale, a black mark under each antennae, a black mark above antennae up to top of vertex, a band on vertex and behind this the usual six dull spots, antennae brown, annulate with pale, basal joint with dark spots; labial palpi scarcely dark near tip. Pronotum dark, a pale median line, and two narrow stripes each side, apparently no long white hairs on sides; meso- and metanotum dark, with a few pale spots, pleura dark, with mostly white hair; abdomen dark, a faint pale streak each side above, above with black hair, below with white.

Legs much dotted and spotted with dark, front femora mostly dark, hind femora dark on apical half above, all tibia with usual two bands, tips of tarsal joints dark, hind tibiae with a dark streak below; spurs equal to three or nearly four joints. In male with much long, fine hair below and on outer side of hind femora.

Wings broad, but tips acute. In fore wings the longitudinal veins largely dark, subcosta, radius, cubitus and anal interrupted with pale; dark spots along cubitus, stigma and rhegma with dark spot; toward outer margin many cross-veins and forks marked with brown, last two radial cross-veins broadly brown, some poststigmal cross-veins also brown bordered; in cubital area many spots near posterior part, a large one at end of cubital fork, and up on the recurrent, back on cubital fork. In hind wings veins mostly brown, longitudinal veins interrupted with pale, a spot at rhegma, and some outer forkings dark.

In fore wing eight cross-veins before radial sector, eleven branches to radial sector, four cross-veins between anal and cubital fork, a dis-

tinct curved recurrent vein, postcubital area very broad, at broadest more than one-half width of wing, second and third anal united only for a short distance.

In hind wing twelve branches of radial sector, two cross-veins between anal and cubital fork, six branches of anal to the hind margin, postcubital area very broad, at broadest about one-half width of wing. Poststigmal cross-veins in all wings.

Length of fore wing 33mm., width 9mm., length of hind wing 31mm., width 7mm.

From Coimbatore, S. India, Nov. to Dec. (P. Susai Nathan).

Navas has made this the type of a new genus because of broad wings, but proportions are about the same in the European *D. annulatus* Klug.

Distoleon pallipenne spec. nov.

Face pale; a large, dark brown spot from below antennae up to vertex, where there are some black lines and rows of dark brown spots; antennae pale yellow brown; pronotum slightly narrowed in front, a little wider behind than long, with a broad, pale gray area in the middle, somewhat narrowed behind, the sides dark, but the upper margin, next the pale is darker than elsewhere, hairs above black, two long curved, white hairs each side; meso- and metanotum broadly pale through the middle, sides dark, scutelli wholly pale; pleura pale, faint traces of a dark stripe; abdomen dull brownish yellow, hair mostly white above, black on sides, and longer white below.

Legs pale, barely dotted and banded with brown in usual places, bristles mostly black, those below hind femora white, in male with long white hair on lower inner side of hind femur; spurs equal to three joints. Wings moderately broad, tips acute, and in hind pair almost concave on outer margin before tip; in fore wings venation pale, longitudinal veins with pale brown streaks or spots, some of the cross-veins, especially costals, partly dark, outer marginal forks and those in apical area brown, also some other forks and a few cross-veins, most noticeably the first radial beyond stigma, stigma hardly noticeable; in hind wing venation pale, hardly with any dark spots, but some outer and apical forks brown; In fore wings six or seven cross-veins before radial sector, thirteen branches of radial sector, four or five cross-veins from anal to cubital fork, ten branches of anal to hind margin, post cubital area at the widest about one-half of wing, the second anal united to third for a moderate distance and the cross-vein from this united part.

In hind wings eleven branches of radial sector, one cross-vein from anal to cubital fork, seven branches from anal to margin, postcubital area at widest about two-thirds of width of wing at that place.

Length of fore wings 26.5mm., width 7mm., length of hind wing 27.5mm., width 5mm.

From Chapra, Bengal, India (Mackenzie). Type M. C. Z. no. 23225.

Nocaldria pallida spec. nov.

Head pale, a short brown band below antennae, one above antennae, vertex with a broad brown band from eye to eye, its hind margin black, antennae pale brown, tip slightly darker; palpi pale; pronotum pale, each side with a broad brown spot on each side margin, about five long, curved, white hairs on each posterior side; rest of notum pale, with dark on sides and at bases of scutelli; pleura pale; abdomen dark, or pale on one or two basal segments and then with a median dark line, venter dark, last segment in male mostly pale, abdomen with very short white hair. Legs pale, femora and tibiae sometimes faintly dotted, tips of tarsal joints scarcely dark.

Wings hyaline, with pale veins. In fore wings longitudinal veins with dark at ends of some cross-veins, a few of the apical cross-veins margined with brown, and a few apical forks also brown; stigma indistinct, brownish.

In hind wings only a few longitudinal veins here and there dark, but a distinct dark cloud from rhegma out to the margin.

Vertex considerably swollen; antennae about one half the diameter of basal joint apart. Pronotum much broader than long, somewhat narrowed in front; each lateral lobe of metanotum with a ridge-like swelling.

Abdomen much shorter than wings, cerci of male pale, as long as last segment, parallel, with much fine hair and above with about six erect black bristles. Legs short, femora thickened, tibia shorter than femur, tarsi a little longer than tibia, first joint very short in front and mid legs, but little longer than the second joint, in hind legs first joint almost as long as second and third together, fifth joint nearly as long as other four together, claws only slightly curved, not one half of last joint; spurs very short, and in some specimens scarcely visible, perhaps absent, sometimes from one half to two thirds the length of first joint, on hind legs, when visible, only about one third of basal tarsal joint; on front coxae are a few long, curved, white hairs, rest of hair very short,

no long bristles anywhere, last tarsal joint with two rows of short spines beneath.

Wings slender; front wings not acute at tip, hind pair more so. Fore wings with seven cross-veins before radial sector, seven branches to radial sector, faint indication of banksian lines, basal cubital fork distinct; eight branches of anal vein to the margin; second anal unites with the third for a short distance; third anal forked.

In hind wing one cross-vein before radial sector, seven branches to radial sector, seven branches of first anal to margin, cubital field mostly with two rows of cells.

Length of body 16 to 18 mm.

Length of fore wing 20 to 22 mm.; width 4 to 4.5 mm. Length of hind wing 19 to 21.5 mm.; width 2.9 to 3.2 mm.

From Bangalore, South India, 21 to 27 April (P. Susai Nathan coll.). Type M.C.Z. no. 23029.

The type of Nocaldria is *signata* Navas (1917) from Abyssinia; Petersen in 1928 gives a figure. According to Navas and Petersen the first tarsal joint is rather longer than in *N. pallida*, but otherwise they agree fairly well. In 1912 Navas described Delphimeus, this was said to have no spurs, and first tarsal joint as long as fifth. In 1927 Navas says Delphimeus has very short, inconspicuous spurs and puts the genus as a synonym of the later Nocaldria. But the difference in tarsal structure would separate them, as well as the broad wing of Delphimeus. Maracanda from Central Asia, said to have very short spurs, has three cross-veins in hind wing before radial sector, and the second anal runs free from the first, so it must go in the Dendroleoninae.

Hagenomyia australis spec. nov.

In general similar to other species, smaller, and with more narrow wings. The face is yellowish, no dark on clypeus, a dark spot between and below antennae, and containing a pale median T-shaped mark, vertex mostly dark, with a narrow median pale line; tips of palpi dark; antennae nearly black; pronotum dark on middle, broadly pale on sides, on posterior part the extreme margin is dark, meso- and metathorax above mostly dark, metascutellum pale, pleura pale, with a dark stripe as usual; abdomen dark brown, paler below, hair whitish; legs pale, faintly darkened in middle of femora and outer base and the inner part of hind tibia; spurs equal to first tarsal joint.

Wings slender, tips nearly acute; unmarked, except the rather small

pale stigmal spot; veins mostly dark, but subcosta, radius and cubitus pale, with dark at ends of cross-veins. Venation not as dense as in most species, for example between cubital fork and first anal vein but three connecting cross-veins, seven or eight cross-veins before radial sector in fore wing, radial sector arising a trifle beyond cubital fork; the costal area has about twenty cross-veins before stigma connected (more than usual); in anal area the series of connecting veins is also longer than usual, lacking but two of the end. The space between cubitus and intercubital line has two series of cells for the first quarter way out, then two and one-half series, the line in most of its distance being as close to hind margin as to the cubitus.

Fore wing 27 mm. long, 6.5 mm. wide.

From Coen, Cape York district, Queensland, Australia, May to June (Darlington). Type M.C.Z. no. 22190. Paratypes from Redlynch, Queensland (Wind).

H. papuensis Weele, which I have seen from New Guinea, has a sinuous dark band below the antennae, between it and the interantennal mark is a pale band extending each side to the eye, the clypeus is entirely dark, the wings are much broader, the costal area noticeably broader.

MICROMIDAE (HEMEROBIIDAE)

Zachobiella pallida spec. nov.

(Fig. 55)

Head yellowish; pronotum more brown, paler on sides, metanotum darker behind; abdomen brown above, pale below; legs pale, unmarked, tibiae swollen; antennae brownish, base paler.

Wings hyaline, veins pale, scarcely marked, the cross-veins sometimes a little darker, a dark cloud at extreme base, extending out a short distance along anal margin.

The fore wing is slender as in the genotype, the apex scarcely pointed; two of the upper gradates form a straight line almost behind the first upper one; marginal forks so small as scarcely visible; outer radial sector with a long fork reaching back before the cross-vein to radius, next fork very short; the costal area is scarcely noticeably swollen near base; in hind wing but two cross-veins.

Length of fore wing 5 mm.; width 1.5 mm.

From Lake Barrine, Atherton Tableland, Queensland, Australia, 18 April 1932, 2300 ft. (Darlington). Type M.C.Z. no. 22386.

Distinguished from *Z. submarginata* Petersen by more slender wings, longer fork of outer radial sector, minute marginal forks, and lack of spots in fore wing.

Zachobiella hainanensis spec. nov.

(Fig. 91)

Head pale yellowish, darker on vertex, pronotum with broad brown stripe through middle, meso- and metanotum dark in middle, pale on sides and in front; abdomen brown above, pale below; legs very pale, unmarked, hind tibiae much swollen, antennae mostly brown, but apical part paler.

Wings hyaline; fore wings with longitudinal venation almost wholly pale, unspotted, but upper branch of medius is dark brown for some distance before tip, but not reaching tip, and upper branch of first radial sector is dark near tip and including fork making a triangular dark area at tip of wing, the lower branch of first radial sector is dark toward tip, but not on marginal fork; cross-veins (except one) are dark brown; the stigma has a scarcely distinct cloud. In hind wings the venation is mostly pale, unspotted, but apical part of first branch of radial sector is dark brown, likewise the apical part of the medius. In fore wing the fork of outer radial sector reaches to the gradates, slightly indenting the row; wings slender as in the genotype.

Length of fore wing 4.5 mm., width 1.5 mm.

From Ta-han, Hainan, 23 and 24 June (Gressitt coll.). Type M.C.Z. no. 22387.

Drepanacra plaga spec. nov.

Body brownish, head rather paler, legs and antennae yellowish brown, fore wings more yellowish, veins pale, often interrupted with pale brown, and sometimes darker brown spots, a large brown spot near the middle of fore wing over the middle cross-veins of the inner gradates, and above toward costa are several smaller spots of dark brown, most prominent on costa, four or five of upper outer gradates bordered with dark, an elongate dark mark over anal area; hind wings with dark cloud before the yellowish stigma, one over the lower part of cubitus, two or three of upper outer gradates dark marked, and a faint cloud near end of medius. In fore wings no fenestrella nor distinct lunule, but the fringe along concave outer edge is pale in patches.

Fore wings falcate at tip about as in *D. instabilis*, the costal area rather broader at base than in *instabilis*. Venation similar to the Australian forms, except that cubitus 2 in hind wing is seen only at base and tip (in some Australian species it is fainter in middle than at ends). Fore wing with six branches to radial sector, first and second soon unite and just beyond the cross-veins separate (I note a similar condition in one wing of a specimen of *D. bioculata*), last radial sector connected twice to radius; four (hyaline) cross-veins in basal series, nine inner and eleven outer gradates.

Hind wing scarcely falcate at tip, costal area at stigma much swollen, six branches of radial sector, first and second (as in Australian species) continued obliquely back to radius, five inner and nine outer gradates.

Male genitalia on plan of Australian species, two bristly elongate processes pressed against tip of abdomen, but not separated much in middle, and the tips rather broad and bent under the abdomen; the lateral wart circular.

Fore wing 9.5 mm. long; 4.5 mm. broad.

From Musha, Formosa, 21 May (Gressitt collector). Type M.C.Z. no. 22388.

Micromus perkinsi spec. nov.

Of the same general appearance as *M. froggatti*, but rather larger and with broader wings; the veins marked with brown as in *froggatti*, but not so heavily, and the marks not as dark. Four radial sectors; the two rows of gradates are not parallel, the inner row more transversely across wing than in *froggatti*, the veinlets but little separated, some almost in a line, and the outer row of gradates make a much less even row than in *froggatti*, the second and fifth veinlets being more remote from the median two.

Expanse 17 to 18 mm.

From the Bundaberg district of Mid-Queensland, Australia (Perkins coll.). Type M. C. Z. no. 11924.

Readily separated from *M. froggatti*, which is very common in Southern Australia, by the difference in gradates, and less distinctly spotted appearance; the two gradate series are nearly parallel in *froggatti*. I have seen no Tasmanian specimens, and if those are the same, then *froggatti* is the same as *tasmaniae*. Tillyard in his table (Proc. Linn. Soc. N. S. Wales, 1916, p. 30) says *tasmaniae* has five branches from the radial sector; in the numerous specimens of *frog-*

gatti I have not seen more than four, and sometimes only three. The New Zealand form has venation more like *M. perkinsi*, but in my two specimens the vertex seems higher.

Berothella Bks.

It differs from Nosybus in no cross vein from medius to radius; in the absence of cross-veins in the apical part of wings; and the costal cross-veins are almost wholly simple (in Nosybus mostly forked). In hind wing three radial cross-veins, and no cross-veins in apical half of wing. Type *B. phantoma* Bks. from Malacca.

Berothella pretiosa spec. nov.

(Fig. 92)

Body yellowish, clothed with yellow hair, face unmarked; antennae pale, a few joints toward apex rufous; abdomen brown above, hair near tip almost golden; legs very pale, with long pale hairs. Wings yellowish hyaline, clothed with long yellowish hair on veins and around margin, but those on costa are shorter and more appressed.

Fore wings with faint yellowish brown clouds arranged transversely, tending to make five or six irregular bands; the cross-vein closing discal cell and that to the medius and from medius to median branch, and the apical third of posterior side of discal cell are black; elsewhere the veins are very pale; hind wings unmarked, and with pale veins. In fore wings four radial cross-veins and most of the cross-veins tend to form a curved line across middle of wing, but few before it and two just beyond it. In hind wings three radial cross-veins, two between radius and its first sector, three between first branch and the medius, one between medius and its branch, and one from medial branch to cubitus; as in fore wing most of these cross-veins tend to form a curved line across the wing.

Length of fore wing 6.2 mm., width 3.5 mm.

From Ta-han, island of Hainan, 23 June (Gressitt). Type M.C.Z. no. 22389.

This differs from *B. phantoma* from Malacca in the heavier marked wing, four radial cross-veins, and in positions of some of the other cross-veins as shown in the figure.

Sisyrina gen. nov.

Similar in nearly all respects and in appearance to *Sisyra*, but the subcosta does not run into radius, and there is a subapical row of gradate veins in both wings.

It differs from *Neurorthus* in lacking the middle (inner) series of gradates, and in much narrower costal area; from *Climacia* in that the subcosta and radius are not united near the tip; from *Sisyrella* in having subapical gradates.

Sisyrina nirvana spec. nov.

(Fig. 36)

Head yellowish brown, hair yellowish; antennae with basal fourth (seven joints) jet black and with black hair, beyond pale yellow, with yellow hair; thorax brownish; abdomen darker brown, especially toward tip, venter paler; legs pale, sometimes hind femora or part of tarsi darker. Wings with dark membrane, veins black, a black line through middle of many of the cells, hair black.

Fore wing with seven sub-apical cross-veins, upper three in a straight line, next a short distance basad, the next further basad, and the next two also. Costal area with cross-veins only in basal part, beyond with granules, the bases of hairs. The genital parts are two stout claspers, curved toward each other.

Fore wing 3 mm. long.

From Nedungatu, South India, 24 Febr. (P. S. Nathan). Type M.C.Z. no. 22390.

NOTHOCHRYSIDAE (CHRYSOPIDAE)

Chrysopa (Indochrysa) nigribasis and varieties

The typical form from Malacca has scarcely any marks on the wing, faint small clouds only, except for the dark marks by the costa near base; all the branches of the cubitus to hind margin are plainly oblique.

Esben Petersen described *C. decorata* from Formosa; it is but a variety of *C. nigribasis*; the branches from cubitus are just as oblique,

the basal costal space as broad, but there are two prominent spots in the fore wing, one over the lower gradate of the outer series, and another over the forking of the first anal vein. This form also occurs on the island of Hainan.

But from another locality on Hainan I have another form; in this there is but one prominent dark spot and this is over the branch of cubitus from the fifth cubital cell, moreover this branch is not oblique, altho all the other branches are. The same condition is found in the two specimens of *C. nigribasis* which I have seen from the Philippines, but in these the dark mark is not as prominent.

I call this form *C. nigribasis* var. *rectoides* var. nov. It is a little smaller than typical *nigribasis*, the face and mesonotum marked the same, and the costal area near base as wide, but it differs in this one cubital branch not being oblique, and having a more or less definite dark spot.

The type is from Dwa Bi, Hainan, 20 July (Gressitt). Type M.C.Z. no. 22663.

Nothochrysa carletoni spec. nov.

Head yellowish, unmarked; palpi pale, antennae black, except the basal joints yellowish; thorax yellowish, a broad reddish (or red-brown) stripe each side on the pronotum and continued back over rest of thorax; legs pale, mid femora with a faint dark band, and basal part of hind femora darkened; pleura marked with red-brown; abdomen brown; wings with the longitudinal veins very pale, also pale are the cubitals, divisory, and most of the branches of cubitus to the margin; the inner gradates wholly dark, the outer gradates very pale as a continuation of the medius; costals dark; radials in part, and also partly dark on the branches of the radial sector, the radial sector itself marked with dark, outer forks brownish; stigma yellowish, very long. In the hind wing the radial sector, its branches, and the inner gradates more or less brown. A brownish spot on hind margin between the first anal vein and the first branch of cubitus, and before this four of the branches of the anals very distinctly brown. Shape of wings similar to *N. aequalis*. In the fore wings 28 to 30 costals; 18 to 20 radials, 8 cubitals beyond the third cell, latter nearly equally divided; 7 branches of radial sector before gradates, about 12 gradates in each series, subparallel, the outer nearer to margin than to the inner row, about 18 branches of cubitus to the hind margin; the post cubital area about one and a half times as wide as the cubital area.

On hind wings about 9 or 10 gradates in each series, the outer much nearer to the margin than to the inner row.

Length of fore wing 22 to 23 mm., width 6.2 to 6.8 mm.

From Kulu, North India (Carleton). Type M.C.Z. no. 20223.

Several specimens, some in poor condition. It will not fit any described species. Needham had his *N. lefroyi* from Kulu, but that is quite different, close to and probably identical with *N. aequalis*. Navas has two species from Sikkim; *N. stitzi* 1924 and *N. talaverae* 1928. His figures of wing base are practically the same; I have this form from Omei Shan, West China. *N. carletoni* is about the size and shape of *N. ludekingi* Weele (*ignobilis* Navas) from Sumatra and Malay Peninsula, but in that species the wing roots are dark, and the venation differently marked, etc.

Ankylopteryx laticosta spec. nov.

Face, palpi, and antennae pale, a brown mark under each eye, vertex greenish, slightly reddish each side by eye, basal and second joint of antenna with a reddish-brown mark on outer side, pronotum pale, greenish on sides, a dark dot each side in front; mesonotum brown in front, rest and metanotum green, abdomen greenish, discolored; legs pale, front tibiae with dark spot in front beyond middle. Wings with greenish venation, base of costa black, and a few black dots beyond, a brown mark from end of third cubital cell down over ends of the anal vein, also a brown cloud over the lower two gradates of inner series, and fainter ones beyond, a black dot at base of radial sector, and toward stigma a few more black dots at end of radials and a brown cloud near by; stigma brown, short, also faint brown clouds in lower part of cubital cells beyond the third, and sometimes faintly other marks; a black longitudinal spot over the subcostal cross-vein. In hind wing similar small clouds, the one over anals very small, and none on lower end of first gradate row; stigma brown, short.

Pronotum a little broader than long; in fore wing the costal area unusually broad, more than twice as broad as the widest part of radial area; divisory cell four-sided, of fair size, five cubital cross-veins beyond it; postcubital area twice as broad as cubital area, first gradate row much curved, the first two or three gradates close together, almost in line, seven in row, second row evenly oblique, about seven and eight.

Fore wing long 16 mm., wide 7 mm.

One from Ta Hian, Hainan, 23 June (Gressitt coll.). Type M.C.Z. no. 23427.

ANKYLOPTERYX FRATERNA spec. nov.

Pale yellowish or greenish on body, antennae, and legs, a brown mark under each eye, basal joint of antennae unmarked; front tibiae with the dark spot, in one specimen a little darker over base of fore wings. Wings with marks and venation very similar to *candida*, but only five cross-veins beyond the divisory cell; inner gradate row no more sinuous than in *candida;* radial sector scarcely bent as far backward as in *candida.*

Length of fore wing 11.5 mm., width 5 mm.

Several from Vo Law, 9 July, Nodoa, 28 to 30 June, 11 July, Ta Hian, 15 June, all Hainan, and Moi Hinon, Kwantung, 8 July (Gressitt coll.). Type M.C.Z. no. 23428.

The four species of Ankylopteryx known to me from China can be tabulated as follows:

1. No spot on front tibia; divisory cell about three times as long as broad, small; basal joint of antenna with stripe on outer side.....*doleschali*
   A dark spot on front tibia; divisory cell broader.....2
2. Basal joint of antenna with dark stripe or mark on outer side.....3
   Basal joint of antenna unmarked.....*fraterna*
3. Base of costal vein black for a short distance; costal area unusually broad; five cubital cross-veins beyond divisory cell.....*laticosta*
   Base of costal vein not black; costal area normal; six cubital cross-veins beyond the divisory cell.....*candida*

Ankylopteryx candida Fabr. I have seen from Szechuan and Fukien provinces of China.

Ankylopteryx doleschali I have from Dwa Bi, 24 July, and Ta Han, 23 June, both Hainan.

CONIOPTERYGIDAE

SPILOCONIS PICTICORNIS spec. nov.

(Fig. 96)

Head and body dark; wings gray, with darker veins and with whitish powder; legs dark on femora and base of tibiae, rest pale; antennae pale yellowish on basal two long joints and also on the next seven, then two joints very dark, then two joints pale yellowish, then seven joints very dark; twenty in all. Fore wings with the apical cross-veins

(or pale lines) in a transverse row, much as in *S. interrupta;* the first swelling on median vein for a bristle is at end of the cross-vein to cubitus; the line (or veinlet) from radial sector starts quite close to the radius and ends on median beyond the end of that from cubitus to median. The hind wings are evenly gray, with darker veins, much as in *S. maculata.* The marginal fringe on both wings is longer than in *S. cerata* or *S. interrupta.*

Fore wing 2.2 mm. long.

From Five-Finger Mts., Hainan Island, 10 June (Gressitt). Type, M.C.Z. no. 22697.

Spiloconis cerata Hagen

(Figs. 2, 3)

In Hagen's series of *Coniopteryx cerata* are two species; one with wings less than two millimeters long is a Malacomyza; the other with fore wings about two and one half millimeters is a Spiloconis. In his description Hagen refers to the two long basal joints of antennae, and to the second sector being bifurcate; these together with the size given show that he was describing the Spiloconis.

The Malacomyza (and that of Enderlein) appears to be *M. ambigua* Withycombe, but the cross-vein from cubitus to medius is a little further basad than in Withycombe's and Enderlein's figures; the fork of medius is longer than fork of radial sector as in *M. ambigua,* and otherwise they agree.

S. cerata Hag. is yellowish; palpi black; antennae with first two joints elongate, pale yellowish, and about eight joints beyond yellowish, beyond that the joints are all dark brown; legs pale yellowish. Wings pale gray, unmarked, veins darker. Vertex elevated and truncate in front, but not as high as in *S. interrupta.*

Fore wings with venation similar to *S. maculata;* the cross-vein from medius to radial sector is oblique and much before the cross-vein from radial sector to radius; the enlarged spots for bristles are about as in *S. maculata,* not very distinct and the bristles delicate.

In hind wing the vein between radial sector and medius arises from the cross-vein much nearer to the radial sector, almost a branch of it.

Fore wing 2.4 mm. long.

The Malacomyza may have been in a later sending from Nietner, as he had two or three sendings from Ceylon.

MANTISPIDAE

Theristria basalis spec. nov.

(Fig. 18)

Head yellowish, marked with brown, a spot on labrum, sometimes one just above clypeus, one below each antenna, usually connected to a larger spot above each antenna, these often connected at outer side to a band across vertex, which is often trilobed in front; basal joint of antennae pale, beyond nearly black, palpi marked with black; pronotum yellowish brown to dark brown, uniform, no pale median stripe; meso- and metanotum dark, often pale in front; abdomen dark, each segment above with an oblique pale mark each side; venter pale; sides showing some pale streaks in female.

Front legs largely pale, inner side of femora dark, outer side often dotted; mid and hind legs with femora, tips of tibiae and the tarsi more or less dark. Wings with dark venation, anals mostly pale, stigma almost wholly dark brown.

Pronotum moderately slender, constricted in middle, anterior part not much wider than posterior part which is scarcely longer than the anterior part; last ventral segment of male short, usually subtriangular, the apex pointed. The front femur is but little swollen, the large inner spine at basal third, outer edge with mostly short teeth, reaching nearly to base, all pale.

The stigma is short, base very oblique; of the three radial cells the second is as long or longer than the others, about six or seven branches to radial sector, seven or eight costal cross-veins, about eight gradates.

Length of body 8 to 14 mm., length of fore wing 10 mm., width of fore wing 2.4 mm.

Ten specimens from Mullewa and Pindarra, West Australia, 15 to 19 Sept. (Wheeler and Darlington). Known by its short wings, short stigma, and the sub-basal position of the long spine of the femur. Type M.C.Z. no. 22100

Theristria stigmalis spec. nov.

(Fig. 15)

Head yellowish, with brownish spots, one on labrum, a triangular one just above clypeus, one beneath each antenna, a larger spot above each antennae (sometimes connected), two submedian reddish brown

lines back to the broad band of posterior part of vertex, sometimes these lines are broad and connected; first and second joints of antennae pale, beyond blackish, palpi dark at tips. Pronotum dark on sides, with a narrow median pale stripe; meso- and metanotum mostly dark, but two oblique pale spots near middle; abdomen dark, with the usual oblique pale mark each side on the segments above, venter pale. Front legs largely pale, but more or less definite red-brown stripes on outside of coxa and femur, inner side of femur with a dark spot toward tip, mid and hind femora mostly dark, but tibiae and tarsi almost wholly pale. Wings with pale venation, yellowish to yellow brown, stigma with an elongate brown cloud.

Pronotum rather broad in front, constricted a little before middle; last ventral segment of male elongate, slender, blunt-pointed. Front legs very slender, the femur scarcely at all swollen, the long spine of inner side is distinctly beyond middle of lower edge, on outer edge the teeth near base are very small, toward tip a few longer ones, the long inner spine is plainly longer than the diameter of the joint, the teeth are partly dark. Stigma extremely long, inner side fully two or three times as long as width of stigma; of the three radial cells the second is a little shorter than the others, nine to eleven branches of radial sector, about nine costal cross-veins, eleven to thirteen gradates.

Length of body 12 to 14 mm., length of fore wings 17 mm. width of fore wings, 4. mm.

From Coen, Cape York, Queensland, Australia, 14 May (Darlington). Type M.C.Z. no. 22099. Readily known by pale veins, very slender wings, very elongate stigma, and very slender front legs, the long spine being placed beyond the middle of the femur.

Theristria medialis spec. nov.

(Fig. 13)

Head yellowish, face with a fine black line each side on the groove, which above antennae becomes a stripe reaching vertex to the black on occiput, an arched black band just above antennae, from this band a median black stripe goes back to the black occiput; basal joint of antennae pale, beyond black; palpi slightly banded with dark, pronotum broadly brown on sides leaving a pale median stripe; meso- and metanotum also black on sides; abdomen above with a pale line each side on each segment; venter pale.

Legs yellowish, front pair with dark streak on outer side of coxa and

femur, inner side of latter with large dark spot, leaving a pale area near base below, tibia dark within; mid and hind legs more or less dark on femur, tip of tibia, and tarsal joints above. Wings with mostly dark venation, costa and radius pale and two or three anals; stigma with an elongate dark spot not occupying one-half its length.

The pronotum appears more constricted than usual, the anterior part more swollen than other species, the posterior part no longer than the anterior part; the last ventral segment of the male is very broad and broadly rounded.

The front femur is moderately fusiform, the long inner spine is placed a little before middle of the lower edge, much beyond basal third, on the outer edge the small teeth reach to the base. The stigma is very long, as long as width of wing at that place; about ten branches to radial sector, eight or nine costal cross-veins, of the three radial cells the second is plainly shorter than the others, about eleven gradates.

Length of body 16 mm. length of fore wing 15 mm. width of fore wing 3.8 mm.

From Meekatharra, West Australia, 22 Sept. (Darlington). The breadth of the anterior part of the pronotum as well as the spines of front femur distinguishes the species. Type M.C.Z. no. 22098.

THERISTRIA DELICATULA var. MINOR var. nov.

(Fig. 14)

Head yellowish, a dark spot on labrum and one just above clypeus, none under antennae, two above antennae, connected, and reaching down each side on face along the groove, above connected on sides and middle to the dark band on posterior part of the vertex, leaving a small pale spot on each side; first and second joints of antennae pale, beyond brown; palpi marked with dark.

Pronotum dark on sides, leaving a narrow pale median line; meso- and metanotum with some pale in middle; abdomen above mostly dark, the usual spots greatly reduced, venter mostly dark, but the ventral plate is very pale as well as the middle part of two or three segments before it.

Legs pale, front coxae and femora with faint outer reddish-brown streak, inner side of femur largely dark, but lower basal part pale; mid and hind femora dark beneath, tibiae and tarsi slightly dark at tips. Wings rather slender, with yellowish brown venation, sub-costa darker towards base, stigma mostly dark in apical part.

Pronotum not very broad in front, posterior part longer than anterior part; last ventral of male rather elongate and broad at tip; stigma quite short, inner edge hardly twice as long as width; of the three radial cells the second is the shortest; about six branches of radial sector, seven costal cross-veins, and about eight gradates. Length of body 7.5 mm.; length of fore wing 8.5 mm., width of fore wing 2.6 mm.

From Cape York, N. Australia, 1867 (Damel) Hagen coll. Type M.C.Z. no. 22097.

Synopsis of Theristria

1. Front femur with the long inner spine but little if any beyond the basal third of lower edge; femur but little longer than coxa 2
   Front femur with the long inner spine much beyond basal third of lower edge, near or at middle of length; femur much longer than coxa 3

2. The three longer spines on outer side about one-half the width of femur, the long spine partly dark; stigma very long; radial sector partly pale; pronotum paler through the middle . . . . . *discolor*
   The three longer spines on outer side not nearly one-half the width of femur, wholly pale; stigma quite short; radial sector wholly dark; pronotum without pale median stripe . . . . . *basalis*

3. Long spine a little beyond middle of joint, and plainly longer than width of femur, latter extremely slender; the stigma as long as width of wing . . . . . *stigmalis*
   Long spine a little or plainly before middle of femur, and not longer than width of femur, latter plainly a little swollen near middle; stigma usually shorter 4

4. On outer side of femur fully ten spines before the first longer one, the series nearly reaching to base, and the two longer ones are not one-half the length of the long inner spine; stigma nearly as long as width of wing; pronotum very broad in front . . . . . *medialis*
   On outer side of femur about five short spines before the first longer one, and the series not reaching near the base; stigma not nearly as long as width of wing 5

5. Long spines on outer side about one-half the length of the long inner spine . . . . . *delicatula*
   Long spines on outer side not one-half the length of the long inner spine . . . . . var. *minor*

Besides the six species in the synoptic table several others have been described.

T. felina Gerst. has been placed as a synonym of *T. delicatula* Westw. by E. Petersen who has seen the type. The description does not agree in all points with a cotype of *T. delicatula* in the Hagen collection.

T. eurysticta Gerst. E. Petersen, who has seen the type, gives a redescription; this agrees very closely with the specimen which I have identified as *discolor* Westw., but nothing is said about the front femur, which in *discolor* is broader than in the other forms.

T. Hillieri Navas. According to the figure of Navas the vertex has two converging lines, this is found in *discolor,* but these are closer with no median line between them; femur I is said to be but little swollen, so it is probably distinct.

Navas has described a new species, *debetazi* as a new genus, *Veura,* because it had a shorter stigma than usual, nevertheless the stigma is crossed by veins. His figures show for markings a form near my *T. medialis,* but in the latter the stigma is longer, the pronotum has the anterior part greatly swollen and is just about as long as the posterior part.

Handschin has lately described a new species, *T. tillyardi,* from the Northern Territory. It has a long stigma as in *medialis* and *stigmalis,* but the markings of head fit neither; the veins are said to be white, this agrees with *stigmalis;* nothing is said of the spines on front legs, so it is impossible to place it at present. It is probable that there are various other species in Australia.

SERICOSTOMATIDAE

Lingora Mosely

Male maxillary palpi slender, tapering, upcurved, clothed with erect, stout, often nearly fusiform hairs, labial palpi moderately long; basal joints of antennae close together, almost one half vertex width, antennae beyond slightly crenulate; vertex with a large elongate wart each side, close to eye, and widest behind the middle; spurs 2-2-4, second pair of legs longest.

Fore wings pointed, with two broad swollen streaks, densely covered with stout black hairs; one over the subcosta, the other over anal-cubital area and at end of anal turns up toward tip of wing, and ends in a point over the base of fork three. Discal cell closed in both wings, three forks in fore wing, others deranged by the swollen area. Hind

wings with forks one, two, and five. In female basal joints of antennae also elongate, fore wing also pointed, venation normal, forks one, two, three, and five; hind wings with forks one, two, and five, also apparently three.

This genus is probably as near to *Pycnocentria* as to any other; *Pycnocentria*, in male, has a swollen streak through the middle of the wing; *Olinga* differs so much in shape of wings and venation, although the posterior streak is similar.

Mr. Mosely has recently described this genus, based on a yellow-winged species from Tasmania.

Lingora plicata spec. nov.

(Figs. 37, 44)

Head black, hair on palpi brown, on vertex reddish to yellowish, basal joints of antennae are densely clothed with black hair, beyond the antennae are almost white for five segments, then brown, annulate with pale, but apical third is almost wholly dark; mesonotum with some tawny hair; legs mostly dark, base of tibia pale, and part of tarsus.

Fore wing clothed with long, stout, black hair, in the male these especially dense on the swollen streaks, and on medius near tip is an area of short stout, erect black hairs. Hind wing with finer black hairs.

In fore wing the radial sector arises near base, the discal cell about three times as long as broad, fork one back on discal cell about width of cell, fork two broad at base on discal, fork three with pedicel one half of fork, the other venation in male is deranged by the posterior swollen streak; in female fork one is back a shorter distance on cell, fork three very long, fork five short, anal running into cubital fork.

In hind wing fork one and two back to cell, fork three a little long, fork five very short. In male hind wing there is no fork three.

The male has a spatulate projection at tip of the venter; the genitalia are small; a pair of sharp processes above, below is a rounded basal plate, and an elongate blunt penis.

Fore wings 4.5 mm. long.

From Barrington Tops, New South Wales, Australia, 5000 ft., 8 Febr. (Darlington). Type M.C.Z. no. 22076.

MOLANNIDAE

Alloecella gen. nov.

A Molannid of the Beraea section; spurs 2, 2, 4; palpi moderately long, porrect, the last three joints subequal; antennae short, clothed with appressed curved hairs, and short erect ones, as is sometimes seen in allied genera, basal joint about as long as the vertex, latter with large elongate wart each side near eyes.

Fore wing with discal cell open and no fork one, the radial sector running close to radius in basal part and apparently not connected to radius, the medius running into it toward base of wing; no fork three, but forks four and five. In the hind wings, which are nearly as wide as the fore wings, is a large median area without veins, the lower side curving up and ending in three veins on outer margin. The fringes are not as long as in allied genera, but the hind wing, near base has some hairs about as long as width of wing.

The venation, especially that of hind wing, is very distinctive.

Alloecella grisea spec. nov.

(Figs. 33, 34)

Body black or brown; head with some white hair, antennae black, legs pale yellowish; wings dark, clothed with black hair, hind wings with more gray hair and fringes.

In fore wings the radius is plainly thicker than other veins; between the radius and radial sector toward base is a fine hyaline line or vein; fork two reaches nearly to the cross-vein (indistinct) to medius, fork four longer than its pedicel.

Male genitalia short and not very distinct, very hairy; there is a long superior piece, the tip slightly bent down, a pair of lower, smooth, slender, pointed and slightly upcurved processes, and a broad ventral lobe with very long bristles.

Fore wing 5 mm. long.

From Mt. Donna Buang, Victoria, Australia, 6 to 7 Dec. (Darlington). Type M.C.Z. no. 22109.

Molanniella gen. nov.

A Molannid; maxillary palpi moderately long, porrect, last joint pointed, almost as long as the preceding one; basal joint of antennae

about as long as the vertex, latter with a large elongate wart each side close to eyes; spurs 2, 4, 4.

Fore wing with apparently forks two, three, and five, the radial sector connecting to radius near base of wing; between radius and radial sector is a wide space except near tip and toward base. Hind wings scarcely broader than fore wings, and with apparently four forks, the longest near hind margin toward base.

Nearer to Molannodes than to Molanna, but the forkings are different.

Molanniella atra spec. nov.

(Figs. 67, 68)

Mostly black, antennæ and legs rather more brownish; wings with black hair.

In fore wing the first fork has a very short pedicel beyond the cross-vein obliquely back to medius, the second fork has a pedicel about two fifths of its length, fork five is broad at base; just before the cubitus joins medius toward base of wing is a cross-vein to the anal vein.

In hind wings the first fork also has a short pedicel, the second fork a pedicel a trifle longer, this cross-vein runs obliquely to the next fork with a branch between them, another unbranched vein, and then a long fork, its base scarcely longer than the fork from base of wing. The female shows some clusters of golden hair at tip of the abdomen above, and below is a small median tooth from the next to last segment, just before the concavity.

Fore wing 6.5 mm. long.

From Mt. Kosciusko, New South Wales, Australia, 5–7000 ft., 11 Dec. (Darlington). Type M.C.Z. no. 22108.

CALAMOCERATIDAE

Anisocentropus solomonis spec. nov.

Dark brown; palpi with brown hair; antennae dark on basal part, beyond pale and annulate with brown; legs yellowish brown. Wings very dark, sparsely clothed with yellowish to golden hair, across the wing from stigmal region to hind margin is a broad irregular band of purplish to bluish sheen, made of minute iridescent scales, the band is broader in front and behind than in middle; fringe is dark, nearly black, in a few places pale; hind wings dark, with dark hair and fringes.

In forewings, which are of moderate breadth, the discal cell is nearly as long as its pedicel, longer than second apical cell, fork one extends back on discal cell two-thirds the length of discal cell, fork two extends back about width of discal cell, fork three extends back a trifle on median cell, fork four is back on median cell to about the middle of cell. In hindwings fork one is very slender, longer than its pedicel, fork two is not nearly as long as one, fork three is back about as far as fork one, cross-vein from medius to fork five is a little oblique.

Two females.

Forewing 8 mm. long.

From Auki, Solomon Islands, (W. M. Mann) Type M.C.Z. no. 22051.

Anisocentropus semiflavus spec. nov.

Head and thorax pale clear yellow, abdomen black; legs pale yellow; palpi pale, last joints with some dark hair; basal joint of antenna pale yellow, beyond brown, but basal half broadly annulate with pale; head and thorax with bright yellow hair.

Fore wings mostly clothed with short yellowish hair, a faint band of darker hair across over the anastomosis, extreme apex also faintly darker; veins brown; hind wings gray, clothed with black hair and black fringes, as a whole much darker than fore wings, the costa with yellowish hair.

In fore wings venation much as others, particularly *A. dilucidus*, the subcosta and radius rather close together, the discal cell slender, its base opposite forking of medius; the apical forks the same except the cross-vein from radial sector to medius is further out on fork three, and the cross-vein from medius to cubitus is nearly straight across, so that fork five is shorter, and the cross-vein from cubitus to anal is fully its length before base of fork five.

In hind wings venation much like *A. dilucidus*, but the wing is not so broad toward base.

Fore wing 8.5 mm. long.

From Lake Barrine, Atherton tableland, 2300 ft., April, Queensland, Australia, (Darlington). Type M.C.Z. no. 22083.

Barynema gen. nov.

Similar to *Ganonema;* maxillary palpi five jointed, third, fourth, and fifth subequal, fifth scarcely curved, second also about as long as third, but heavier.

Discal cell in hind wings plainly closed. In fore wing the anal runs into cubital fork.

Fore wing not nearly as elongate as in *G. pallicorne*. *Ganonema* should be held for forms closely related to the genotype.

Barynema costatum spec. nov.

(Figs. 43, 51, 54)

Head black; thorax shining black above; abdomen dull black; antennae and palpi blackish, unmarked except basal joint of antennae is a little paler; legs blackish, spurs brown. Wings blackish, being densely clothed with black hair; fore wings with a stripe of golden hair along anal vein, fully half way to end of vein, and a curved pale band over the anastomosis, but not reaching to either margin, in front the band has mostly white hair, but behind it is almost wholly yellowish; the cross-vein to end of anal is hyaline white; hind wings unmarked. In fore wings the venation as figured, costal margin thickened; forks one and two both sessile on discal cell, fork three shorter and pedicellate, anal apparently runs into fork of cubitus or an oblique cross-vein from cubitus; in hind wings discal cell plainly closed, fork one back a short distance on cell, fork two reaches the cell, fork three pedicellate, fork five fairly long.

Male genitalia show above a pair of elongate tapering superior appendages, below is a shorter upturned pair of interior appendages, and projecting between is a stout, blunt penis.

Fore wing 9.5 mm. long.

From Mt. Donna Buang, Victoria, Australia, 6, 7 Dec. (Darlington) Type M.C.Z. no. 22082.

LEPTOCERIDAE

Symphitoneura wheeleri spec. nov.

(Figs. 53, 70, 71)

In general very similar to *S. exigua*, a little larger, general color and hair the same and in the female the venation (which is almost like *Notanotolica opposita*); the discal cell in hind wing rather longer than in *S. exigua*.

In the male the radial sector runs so close to the much broadened medius that the discal cell is not one half as wide as in *exigua*, and difficult to see the base of cell; the first branch from the medius, which in *exigua* has a backward angle near base, in *wheeleri* is an even curve, and the next two branches seem almost unconnected at base.

In the male genitalia, which is extremely hairy, there is a pair of fairly broad plates above, subparallel (in *exigua* much narrower plates); the broad lateral claw-tipped pieces of *wheeleri* in *exigua* are bent at a right angle before the middle, and the apparently rounded tip ends between the pair of slender ventral processes; the median hyaline hood over the penis in *wheeleri* has chitinous margins tapering to a point, in *exigua* these margins end bluntly.

Fore wing 11 mm. long.

From Rottnest Island, West Australia, 23 Oct. (Wheeler). Type M.C.Z. no. 22078.

I give figures of the genitalia of a male *exigua* from King Island, Tasmania (Fig. 8).

The *S. fulva* Navas from New Guinea is quite possibly a different genus. There is a chance that the male of *Notanotolica opposita* may show that species to be a *Symphitoneuria*.

Notanotolica parva spec. nov.

(Figs. 4, 62)

Dark gray, mottled with pale; antennae of male dark, narrowly annulate with white; face with white hair, but a row of black close to eye. Fore wings with black, brown, and white hair in patches and streaks similar to *N. magna*. Venation also very similar to that species, the apical area beyond the anastomosis is very long; fork one hardly longer than pedicel, fork three with short pedicel, the cell above very wide at base.

It differs in the smaller genitalia, and in that the apical part of claspers is shorter than in *magna* and the lower, smooth, pointed process reaches to the tip of the apical part, and can be seen from above; the superior, bristly appendages are narrower than in *magna*, and the triangular plate at base larger, or more exposed.

Fore wing 13 mm. long.

From Ravenshoe, Atherton tableland, Queensland, Australia, 3000 ft., 27 April (Darlington). Type M.C.Z. no. 22077.

Triplectides elongata spec. nov.

(Fig. 39)

Body dark, head with white hair, and some black; palpi with mostly black hair, antennae brown, narrowly annulate with black. Wings gray, with gray and whitish hair, and some black especially along the veins. In fore wings the discal cell wider than in *delicatula*, fork one shorter than pedicel, fork three with a pedicel one fourth its length; in hind wings the fork one is present and the other forks longer than in *delicatula* or *flava*.

Male appendages show the usual parts very slender; superior appendages very long, but the ventral ones still longer, the lateral with a long curved piece and a slender apical part full as long, the basal piece below has a row of very long bristles arising from tubercles; the median piece is long, slender, bilobed, the lobes down and incurved.

Fore wing 14 mm. long.

From Blackheath, Blue Mts., New South Wales, Australia, 21 Jan., 8000 ft., (Darlington). Type M.C.Z. no. 22079.

A female from Barrington Tops, New South Wales, 9 Febr. is probably the same form, tho the fork one is longer. This is maybe *T. australis* Navas, but the length of forks is different and his description of genitalia gives no clue; besides *T. delicatula* Ulmer, I have a female of apparently another species.

Triplectides australica spec. nov.

(Figs. 47, 66)

Body yellowish gray, head, thorax above, and legs with mostly white hair; antennae pale, narrowly annulate with black at tips of joints. Wings with white, yellowish, and black hair in patches, much as other species, in male hind wings darker than fore wings.

Fore wings with venation similar to *flava*, but fork one is much longer than its pedicel, and fork three reaches almost to the cross-vein; in hind wings fork one is present, and the other forks behind are longer than in *flava*. Male genitalia have a pair of slender superior appendages, the lateral ones are large, but not very long, the apical part hardly longer than the basal, and, seen from beneath, shows a process with sharp point (similar to that in *Notanotolica*); the median process is broad and slightly bilobed at tip.

Fore wings 12 to 13 mm. long.

From Ravenshoe, Atherton tableland, Queensland, Australia, 2000 ft., 27 April (Darlington). Type M.C.Z. no. 22080.

LEPTOCERUS DARLINGTONI spec. nov.

(Figs. 48, 63)

Head and thorax black, abdomen scarcely paler; palpi dark brown, as also basal joint of antenna, beyond pale and narrowly annulate with dark; head with some short white or yellowish hair and longer black hair; legs brownish; fore wings nearly black, veins brown to black, with short black hair, a hyaline white mark over cross-vein from discal cell to medius; hind wing paler, with black hair.

Fore wings acute at extreme tip, shape and venation much as in *L. albifrons;* discal cell with oblique end, fork one with rather long pedicel, fork three with a pedicel about one third of fork, fork five broad and oblique at base.

In hind wings, which are plainly broader than front pair, fork one is short, fork three only a little longer, fork five long and tapering to a point at base.

Male genitalia have above a pair of slender, parallel superior appendages, bent down near tip, and beneath a pair of outcurved reddish pieces; large and much shorter pieces below.

Fore wings 8.5 mm. long.

From Aldgate Mt., Lofty Range, South Australia, 29 Nov. (Darlington). Type M.C.Z. no. 22081.

HYDROPSYCHIDAE

MACRONEMA TRISTIS spec. nov.

(Figs. 58, 61)

Head black, a large pale spot below each eye; palpi pale; antennae pale, basal joint dark above, beyond dark at tips of joints; thorax dark, mesonotum nearly black; legs pale, tarsi rather darker; abdomen dark above and below. Wings dark gray, clothed with short black hair; in fore wings between veins are a number of yellowish spots of good size, but not especially bright; one occupying most of discal cell, one above and just before and two above and just beyond discal cell, first apical cell with one at base and one at tip, second cell with two also, third cell

(fork two) with two near base and four near tip, fourth cell with two near base, three beyond middle, and one at tip, fifth cell with several nearly confluent spots, sixth with three near base, two near middle, and one at tip, seventh cell with one near base, two near middle, and one at tip, eighth with two near base, one near middle, and one at tip; anal cell with a row, and several spots between anastomosis and base of wing. In fore wing discal cell short, triangular, fork one with a pedicel nearly equal discal cell; fork two at lower angle of discal cell, fork three scarcely a bit further back than two, fork four back further, before the base of discal cell. Male appendages show two slender ventral claspers, apical part much incurved, two short curved submedian pieces, from above, seen as divergent plates, with hyaline inner half, above them a pair of short, hairy projections; tip of penis forked.

Fore wing ♂ 11 mm., ♀ 8 mm.

From Ravenshoe, Atherton tableland, 3000 ft., 27 April, and Rock Scrub, McIlwraith Range, 17 to 29 June, both Queensland, Australia (Darlington). Type M.C.Z. no. 22085.

Macronema ethelda spec. nov.

(Figs. 23 below, and 27)

This is similar in wing-marks to *M. pseudoneura* and is figured as probably that species by Martynov (Rec. Ind. Mus. XXXVII, p. 189). I have but one specimen of *M. pseudoneura*, and it agrees well with Ulmer's figure, and also with the veins at base of the fourth apical cell. The new species differs in that there is no appendix to the stigmal band directed toward the curved mark, but an elongate spot in the second apical cell. The basal spot is much larger than in *pseudoneura*, and the second band is plainly bent near hind margin. The pale bands are bordered by dark, and between are golden spots as in *pseudoneura*. The apical fringe is shorter than in *pseudoneura*. The discoidal cell and venation at base of the fourth apical cell are as in most species, the fourth apical cell reaching to before tip of discoidal cell. On the front tibia the tip is distinctly dark (not in *pseudoneura*). The genitalia are on the same plan as in *M. pseudoneura* but the basal part of the claspers (seen from below) is shorter, and plainly broadened near tip (not in *pseudoneura* Fig. 23.); the superior plate is more deeply indented in the middle than in *pseudoneura*.

Fore wing 7 to 11.5 mm. long.

From Shimoga, Mysore, India (Susai Nathan); many specimens. Type M.C.Z. no 22676.

In practically all of these specimens the stigmal band is more narrowed behind than in Martynov's figure, and agrees with *pseudoneura* in this respect, altho perhaps not quite as oblique.

Hydropsyche dolosa spec. nov.

(Figs. 93, 101, 105, 106)

Head and thorax above with mostly yellowish gray hair, some black each side behind posterior warts and each side on pronotum; antennae pale, ringed as usual; palpi brown; legs pale, hind tibia of male with moderately long pale hair, spurs pale. Fore wings pale, indistinctly marked, more plainly on front and hind margin, and especially toward tip where the spots become nearly black; outer fringe black, a few pale interruptions; hind wings pale gray. Venation much as usual; fork one with pedicel nearly as long as discal cell, fork three with pedicel about one third of fork; in hind wings fork one short, but distinct. The superior plate of male genitalia has a median subangular incision, and each side a slender, filiform appendage, somewhat thickened toward tip (not as long as in *appendicularis*); the clasper has the apical joint of moderate length, tapering, and its apical half bent inwardly; the penis has a bilobed tip (divergent in one specimen, in others the lobes are bent upward), seen from the side there is a minute elevated point and before it a process with an angled side lobe, these are seen from below, from above before the lobed tip is a lobe each side, projecting laterally a little.

Length of fore wing 8.5 mm.

From Gang Ken, southwestern Fukien, 25 July, and Yim Na San, eastern Kwantung, 13 June, China (Gressitt). Type M.C.Z. no. 23429.

Hydropsyche complicata spec. nov.

(Figs. 88, 94, 99, 100)

Head with pale yellowish hair, considerable black behind on vertex (less black in female); thorax with the same yellowish hair, some black on sides of pronotum; palpi dark brown; antennae very pale, with broad dark rings; abdomen black above, pale beneath; femora and tibiae largely dark (in female much paler), spurs pale. Fore wings

dark, with many small spots of yellowish hair all over, getting smaller and more numerous toward tip, where some are in transverse rows; outer fringe dark, with two pale interruptions; hind wings gray. Venation much as in others; fork one with a pedicel much shorter than discal cell, fork three with pedicel hardly one fifth of fork; in hind wing fork one is small. Male genitalia show a superior plate with a median angular incision, and each side a rather stout, clavate process, which, seen from side, is curved downward; claspers have the last joint moderately long, straight, and, from above, tapering, from side appear broader until near tip; the penis has an elaborate set of processes; the swollen tip shows (from above) a broad apical cavity containing each side a lobe tipped with three fine black bristles or spines, before this is a minute round button, at the narrowed neck is a large dark lobe each side, from above rounded, and before this is a dark process each side, broad in front, tapering to a spine behind and having above an elevated lobe, seen from the side the basal part of penis is upcurved and thick, the two dark lobes near tip very prominent, and before the first is a long, curved bristle.

Length of fore wing 8.5 mm.

From Yim Na San, eastern Kwantung, 10 to 16 June, China (Gressitt). Type M.C.Z. no. 23430

Hydropsyche bryanti spec. nov.

(Figs. 35, 38)

Head dull yellowish, with rather short gray or yellowish gray hair; palpi and antennae yellowish, latter narrowly annulate with brown; thorax with the same yellowish-gray hair; legs and spurs yellowish; abdomen brown above, paler beneath, genitalia pale. Forewings clothed with appressed yellowish and gray hair, faintly marmorate with pale brown, dark spots along costal border and outer margin, a larger one at end of first apical vein, fringe partly dark; hindwings yellowish gray, fringe dark gray.

In forewings fork one is about three times as long as its pedicel, fork two back a trifle on discal cell, fork three nearly four times as long as its pedicel, fork four extending on median cell fully one-half width of cell.

In hindwings fork one is much shorter than its pedicel, fork two extends back on discal cell two-thirds the length of the cell, up to the cross-vein, fork three nearly twice as long as its pedicel.

The male genitalia are somewhat like *H. hamifera* Ulmer from Celebes. The superior piece is broad, with two slender apical downcurved processes, at first bowed, then parallel to each other, the tips minutely dentate or serrate (in *hamifera* pointed and crossed), from the side there is a tooth above each slender process. The claspers are moderately slender, the thickened part with several stout bristles, the apical piece slender, curved, and pointed; the tip of the penis seen from above (or below) is widely forked, toward base is a recurved tooth on each upper side.

Forewings 9.5 mm. long.

From Mt. Salak, Java (Bryant and Palmer). Type M.C.Z. no. 22065. In appearance it is similar to *H. javanica*, but the genitalia very different.

Hydatopsyche decepta spec. nov.

(Figs. 87, 90, 95)

General appearance of an Hydropsyche or *Diplectrona taprobanes*, marked much as the latter species, faintly marmorate with brown, with scattered pale spots. The venation much as in *H. melli*, the discal cell even longer than in that species, and the median fully as long; fork two goes back on the discal more than one half way, and fork three reaches to tip of the median cell. The male genitalia are quite different from *H. melli*, the superior plate has a median tapering process, and each side of it come the preanal appendages, the apical part very slender; the claspers are long, the apical joint short, the tip pointed; the penis has the tip slightly swollen, apparently with an apical cavity from which arises two small elongate processes, which, seen from the side, curve downward. The antennae of male are fully as sharply crenulate as in *H. melli*, and the legs and claws the same.

Length of fore wing 8 mm.

From Ta Hian, 13 to 17 June, and Fan Hoang, 20 June, both in Hainan Island and taken by Gressitt; much smaller and less spotted than *H. melli*, which was taken by Gressitt in southern China. Type M.C.Z. no. 23431.

Hydropsychodes pulchripennis spec. nov.

(Figs. 17, 20)

Head brown, with some pale yellowish hair, palpi and antennae pale, latter faintly annulate with brown; thorax brown, with some

yellowish hair; legs dull yellowish, spurs hardly darker; forewings brown, with about seven large spots, two in apical field sometimes connected, a subquadrate one over discal cell and above it, sometimes almost connected to a spot before it; the subbasal spot sometimes extended to base along hind margin; hindwings hyaline, the tip and fringe almost black.

In fore wings fork one is a little longer than its pedicel, fork two sessile on discal cell, fork three about three-fourths of two, extending back to tip of median cell, forks four and five subequal; in hindwings fork two is back on discal cell about width of cell, fork three scarcely longer than its pedicel.

Male genitalia shows a triangular superior median piece and each side of it a lateral appendage with an angle on the outer side near base; the claspers are very slender, moderately enlarged toward tip, the apical part enlarged almost globose and with a sharp curved tip; the penis has a slightly enlarged tip and from below appears bilobed.

Forewing 7 mm. long.

From Namoe Oengas Estate, Langkat, East Coast, Sumatra (Jourin).

Type M.C.Z. no. 22062.

Although in appearance it is much like *H. albocincta*, the genitalia are very different; I give a figure of *H. albocincta* (Fig. 19).

Smicridea ulmeri spec. nov.

(Fig. 5)

Head dark, with snow-white hair, and also on the thoracic notum, palpi, legs, and abdomen yellowish, antennae pale, slightly annulate with dark; wings white, scarcely darkened in the stigmal area of the fore wing; venation much as in the other species, fork one not as far back as two and three, hardly as long as its pedicel, forks four and five very long.

Male genitalia show a short and broad superior plate, with a broad emargination at tip, the claspers have the apical part short, and somewhat tapering to the tip, the penis is only a little swollen at tip.

Fore wing 5 mm. long.

From Ravenshoe, Atherton tableland, 3000 ft., 27 April, Queensland, Australia, (Darlington). Type M.C.Z. no. 22092. This is evidently what Ulmer (Trichoptera, Mjoberg's Swed. Exp. 1910–1913, p. 15) refers to under *S. australis*, since it was from a nearby locality,

and as he said was very pale, and had the apical part of claspers shorter than in *S. australis*.

Smicridea parva spec. nov.

(Fig. 41)

Head blackish, with white hair and also white hair on the thorax; palpi brownish; antennae pale, above annulate with dark; legs pale; abdomen brown, genitalia pale. Fore wings mostly white in male, usually a large brownish stigmal mark, and sometimes darkened irregularly along tip, and two large spots (sometimes connected) along hind margin; in female usually with these large dark spots or almost entirely dark; hind wings white.

The fore wings have the venation similar to others; however the fork one goes as far back as fork two, forks two and three about equal, fork four very long, reaching back a little further than five, discal cell slender, nearly six times as long as broad, cross-vein from cubitus to anal very oblique backwards, and before the cross-vein from cubitus to medius. Male genitalia have the claspers much like *S. edwardsi*, the apical part much shorter than basal part, very slender, a little curved, but not tapering to tip as in *S. edwardsi;* the basal piece (from side) has the tip scarcely upturned, the penis is enlarged at tip.

Length fore wing 4.5 mm.

From Pemberton, West Australia, 19 Nov. (Darlington). Type M.C.Z. no. 22091.

Much smaller than others except *S. australis*, from which it is readily known by the much shorter apical part of the claspers; many specimens.

Sciops spinata spec. nov.

(Fig. 31)

Body deep black, lateral warts of head and prothoracic warts pale, genitalia paler, and penis pale yellow. Head and thorax with black hairs above, palpi and antennae black; legs dull yellowish brown, tarsi darker, hair black; both pairs of wings densely clothed with black hair.

Head with a pair of large oblique posterior warts, and two very small ones each side in front; third joint of palpus longer than second. Fore wings with discal cell two and a half times as long as broad; fork one

with pedicel longer than width of discal cell, fork two back almost to cell, fork three but little longer than its pedicel, fork four reaches only a little before cross-vein, fork five as long as four. In hind wing fork one a little longer than its pedicel, fork two with a short pedicel, fork three no longer than its pedicel, fork five with pedicel nearly one half its length. Abdomen extremely broad, and the genitalia very small; from above an elongate triangular piece with rolled and black edges, within paler; below it a large median piece projects, its apex forked and with a broad ridge each side; the claspers small, basal joint moderately enlarged at tip, apical joint slender, pointed; penis thick, bent down, at tip with a pair of upright spines.

Fore wing 6 mm. long.

From National Park, McPherson's Range, Queensland, Australia, 13 March, 3–4000 ft. (Darlington). Type M.C.Z. no. 22088.

Sciops inermis spec. nov.

(Figs. 9, 11)

Body black, warts brown, head and thorax with some dark hair, antennae, palpi, and legs brown, spurs paler. Wings uniform blackish, with black hair; hyaline white spots in fore wing over forking of medius, and over cross-vein from discal cell to medius, less distinctly over end of discal cell.

Fore wings with discal cell over four times as long as broad, median cell about as long as discal, and scarcely wider, fork one with pedicel about one half length, fork two back to discal, fork three with pedicel fully one half its length, fork four about width of median cell back on cell, fork five about same length, but wider toward base; in hind wing fork one only little longer than pedicel, fork two back to discal cell, fork three but little more than one half of fork two, fork five back to about middle of discal cell.

Abdomen of male very broad and flattened; genitalia (except penis) small and inconspicuous; and the claspers close to abdomen. Above is a triangular piece, just below it each side a small, slender, pale piece, then a large piece whose tip (seen from side) has a blunt process above, from below this extends the large, blunt penis, which (seen from above) is seen to have a median part and a rounded, almost hyaline extension along each side, the outer edge of which is thickened. The claspers are slender, tip fairly enlarged, apical part curved, slender, and pointed at tip.

Fore wings 6.5 mm. long.

From Wentworth Falls, 3 Jan., and Blackheath, 18 Jan., both in the Blue Mts., New South Wales, Australia (Darlington). Type M.C.Z. no. 22089.

I have put these two species in *Sciops* largely because of the very broad abdomen and very small genitalia; the venation is similar to *Diplectrona*, but those species have a slender cylindrical abdomen in male. Neither of the species has the third joint of palpus as long as McLachlan states for his two species. I think that these proportions vary in both *Diplectrona* and *Smicridea*. *Smicridea* (Australian species) has the fork four plainly a little longer than five, and the vertex warts are not as large as in these *Sciops*.

Diplectrona angusta spec. nov.

(Figs. 16, 49)

Head brown, posterior warts pale; palpi brown, antennae pale, beyond base annulate with brown; prothoracic warts pale, rest of notum brown, except pale mesoscutellum, pleura and beneath more yellowish; abdomen brown; legs yellowish, spurs also.

Fore wings brown, sparsely clothed with short black hair, the three cross-veins, forking of medius, and end of anal veins faintly white; hind wings gray with short black hair.

Fore wings more slender than usual; discal cell about five times as long as broad, fork one with a short pedicel, fork two back on discal less than width of cell, fork three scarcely longer than one, with a pedicel two thirds its length, fork four a little longer than two, back on median cell more than width of cell, fork five a little longer and plainly wider than four, cross-vein from radial sector to medius oblique, and that from cubitus to anal also oblique.

In hind wings discal cell still more slender, fork one with very short pedicel, fork two back a little on discal, fork three no longer than one, and with a pedicel about its length, fork five long and wide.

Male genitalia have a superior plate with a slender lateral process each side curving in toward its fellow, the claspers rather short and heavy, the apical part short and pointed, the penis is enlarged at tip.

Fore wing 10 mm. long, 4 mm. wide.

From The Dorrigo, New South Wales, Australia, 3000 ft., 27 Febr. (Darlington). Type M.C.Z. no. 22087.

Austropsyche gen. nov.

Related to Diplectrona and Sciops; spurs 2-4-4; in fore wings fork four equal to five; in hind wings the subcosta and radius run close together to near middle of discal cell, where they are connected by a very short cross-vein, and then separate, the radius bending behind but not so much as in Diplectrona so as scarcely to approach the discal cell and the space not narrowed; discal cell very elongate; costal area rather broader than in allied genera, not narrowed near middle, and with an oblique costal cross-vein before middle. Maxillary palpi with last joint very long, equal to rest of palpus, third joint rather longer than fourth, but scarcely, if any, longer than second. On the head the posterior warts are greatly enlarged so as to crowd the intermediate wart close to the anterior wart.

Austropsyche victoriana spec. nov.

(Figs. 6, 7, 10)

Head dark, the warts pale, with rather scant mostly blackish hair; palpi brown; antennae pale, joints beyond base annulate with dark; pronotal lobes pale, rest of thorax above dark, except a rather pale area through the middle; abdomen brown above, paler below; legs yellowish, tarsi rather more brown, spurs pale, hind tibia of male moderately long-haired behind.

Fore wings gray, with darker stigmal area, and toward tip, clothed with sparse black hair, five hyaline white spots, one at end of anals, one over forking of medius, and one over each of the three principal cross-veins; hind wings pale gray, with gray and some black hairs, outer fringe dark.

In fore wings discal cell is over five times as long as broad, fork one with a pedicel one-half its length, fork two reaching back on discal cell hardly width of cell, fork three about two thirds of two, and with a pedicel one half its length, forks four and five subequal, but five reaching back a little further and wider toward base. In hind wings the discal cell also very long, fully equal to second apical cell, fork one with short pedicel, fork two reaching back on discal cell about width of discal cell, fork three with pedicel one half its length, three cross-veins well separated as in the fore wings.

Male genitalia have the claspers rather stout, with a tooth on the outer side toward tip of basal part, the apical part (from side) clavate,

but the sharp tip is incurved, there is a dark basal superior plate, subtriangular, and beneath it a broad pale piece with some bristly lobes on the side; the penis has a slender apical part projecting from a broader tube, from side this is bilobed.

Fore wing, male 11.5 mm., female, 14.5 mm.

From Mt. Donna Buang, Victoria, Australia, 6 to 7 Dec., and from Du Creek, Warburton Range, Victoria, 6 Dec. (Darlington). Type M.C.Z. no. 22086.

Stenopsychodes tillyardi spec. nov.

(Fig. 60)

Head yellow, clothed with golden hair; antennae brown, basal joint yellowish, palpi black; thorax black, pronotum with golden hair, and along middle of mesonotum, and a tuft of golden hair at base of fore wing; abdomen black, superior appendages pale, others black, on venter three segments near tip pale with a darker central triangle (similar to male *melanochrysa*); legs black, tarsi paler, spurs yellowish to brown. Wings black, with short black hair; fore wings with numerous golden spots between veins, and the anal area almost wholly golden, only a few slight dark interruptions.

Fore wings with discal cell nearly four times as long as broad, fork one back a little on discal cell, fork two back one half way on discal cell, fork three with a pedicel one half its length, forks four and five are nearly equal, pedicel of five about two thirds of pedicel of four.

In hind wing discal cell is rather more slender, fork one scarcely back on discal, fork two back one half way on discal cell, fork three with pedicel fully one half its length, fork five very large and long. The male genitalia are most like *S. mjöbergi* Ulmer; the lateral appendages are more rounded at tip, the ventral appendages, from side to side, have the apical part more slender, and, from above, also more slender and longer, the inner hook very large and nearer base than in *mjöbergi*.

Fore wing ♂ 12 mm. long, ♀ 15 mm. long.

From Millaa Millaa, Atherton tableland, 2500 ft., Queensland, Australia, April 1932 (Darlington). Type M.C.Z. no. 22084.

Readily separated by the yellow anal area of fore wing. Darlington took *S. montana* at Donna Buang Mt., Victoria, and W. Heron sent *S. melanochrysa* from The Dorrigo, New South Wales.

These insects are not especially near Stenopsyche, except in general plan of genitalia, and the length of forks four and five; the absence of

ocelli, the tiny warts on mesonotum, as well as the peculiar mouth parts warrants a separate tribe, the Stenopsychodini, equivalent to the Stenopsychini and Polycentropini; from the latter readily separate by the longer fork four and flat vertex.

Philopotamus stenocerca Tillyard

(Fig. 50)

This species, which I first supposed to be new, I am surprised to find was described by Tillyard as a new genus, *Hydrobiosella*, a subdivision of *Hydrobiosis*. The maxillary palpi are like the common European forms, the last joint being longer than in most of the species; there are no erect hairs on veins, and the venation is like that of the European species, except that fork one reaches back a short distance on the discal cell in both wings (sometimes sessile in European forms). The genitalia are very much like the usual *Philopotamus*, utterly different from *Hydrobiosis*. The fore wings are a pale brown, with innumerable small yellowish spots, much more numerous than usual; behind the fork five there are about twenty such spots.

I obtained two specimens from Mr. Hudson many years ago mixed in with specimens of *Philanisus*.

Plectrocnemia australica spec. nov.

(Figs. 65, 69)

Head brown, with dull golden and black hair; palpi yellowish brown, antennae dull yellowish, annulate with pale brownish; pronotum with mostly black hair, mesonotum with golden and black hair; abdomen dark brown; legs dull yellowish, hind tarsi faintly marked with darker.

Fore wings gray, with black hair, and with numerous very small patches of golden or yellowish hair, a few larger ones along the costal area, a curved white hyaline line from fork of medius to cubitus; hind wings gray, with black hair.

In fore wings discal cell about three times as long as wide, fork one hardly equal to its pedicel, fork two back a trifle on discal cell, fork three short and with very long pedicel, fork four hardly longer than three, fork five very long and greatly widened at base, more so than in other species.

In hind wings discal cell small, about twice as long as wide, fork one a little longer than pedicel, fork two back to discal cell, fork five long and very wide.

Male genitalia show a pair of lower claspers, subparallel and with tips somewhat enlarged, longer than usual and strongly upcurved, a superior median, tapering piece, and beneath it two pieces extending out to tips of claspers or beyond and with sharp points, and on each side a broad, elongate oval piece, tipped with long hairs. There appears to be a median translucent plate, vertical from between the claspers up in a curve.

Fore wings 7 mm. long.

From Mt. Kosciusko, New South Wales, Australia, 5000 ft., 8 Dec. (Darlington). Type M.C.Z. no. 22090.

RHYACOPHILIDAE

Hydrobiosis

When Ulmer described his *H. stigma* he mentions that it is not typical and compares it in certain points with the American *Atopsyche;* it is, however, quite different from that genus. Since Tillyard has divided the New Zealand *Hydrobiosis* into several genera it is to be expected that the Australian forms will also belong to new genera. *H. stigma* and the two species described below as *pallescens* and *nigrita* I unite in a new genus differing from *Hydrobiosis* in the much longer discal cell, and fork two reaching the discal cell.

Notiobiosis gen. nov.

In general similar to *Hydrobiosis;* the anastomosis being before the base of the stigmal region, the spurs 2–4–4; discal cell closed, and several times as long as broad, fork one reaching to discal cell, fork two going back on discal cell or at least reaching to it.

Type *N. pallescens.*

Notiobiosis pallescens spec. nov.

(Fig. 40)

Head yellowish, clothed with white hair; palpi pale; antennae pale, faintly annulate with brown; thorax pale, white hair on prothoracic

warts and on middle of mesonotum; abdomen brownish, paler beneath; legs pale, tibiae slightly darker near middle and at tip, and tarsal articles often marked with dark.

Fore wings pale brownish, with many white and yellowish scales and some scattered black hairs, longer white erect hairs on the veins and some black hairs, most noticeable near forking of medius and behind, apical fringe white, veins brown in streaks, interrupted with paler; stigma brown. Hind wings pale, with gray hair and fringe. On fore wings several hyaline white lines near middle, a fine line just above the medius, a transverse bar crossing medius some distance before forking, the cross-vein from radial sector to medius, and a mark from cubitus to end of anal veins.

In fore wings fork one reaches discal cell, fork two back on discal cell for nearly width of cell, fork three about as long as its pedicel, fork four no longer than three, fork five much longer than four and more slender at tip, discal cell about four times as long as wide, cross-vein from medius to cubitus obliquely back. In hind wings fork one very narrow, reaching back to the cell, fork two obliquely broad on cell, fork three longer than its pedicel, fork five with a short pedicel.

The abdomen has on venter, from sixth segment, a spine about as in *N. stigma* Ulmer, and at tip of seventh a short erect one with a truncate tip, shorter than *N. stigma*.

Length of fore wing 10 mm.

From Pemberton, West Australia, 19 Nov. (Darlington). Type M.C.Z. no. 22093.

Readily separated from *N. stigma* by the size of forks of hind wings, as well as the longer fork two in fore wings, and coloration.

Notiobiosis nigrita spec. nov.

(Figs. 45, 46, 72)

Head black, clothed with black hair; palpi brown; antennae brown, faintly annulate with pale at the joinings; thorax black and with rather long black hairs; the prothoracic warts pale; abdomen black; legs pale, tarsi rather brownish.

Fore wings blackish, with black hair and fringe, stigma very dark and prominent, there are a few patches of golden hair at ends of anal veins, on cubitus before forking, and others near the anastomosis, these on the veins, and on the membrane at tip of stigmal area is a yellowish spot. Hyaline white lines as follows:—one up from end of

anals, one over cross-vein from radial sector to medius and this extending down to the base of fork four; veins uniform brownish. Hind wings gray, with black hair and fringes. In fore wing discal cell is over three times as long as broad, fork one sessile on cell, fork two back fully width of cell, fork three longer than its pedicel, fork four still longer, and about as long as fork five, cross-vein from medius to cubitus obliquely back. In hind wings fork one has a short pedicel, fork two obliquely back on cell, fork three with pedicel one half its length, fork five long and wide.

Male genitalia show a median blunt process, a very slender piece each side, and below a long, broad clasper, tapering toward the incurved tip, and below these a pair of short curved slender pieces, from above one sees a broad penis with truncate tip. The claspers, from behind, are seen to be fringed on the lower inner edge with a row of long, curved bristles. On the sixth ventral segment is a stout spine reaching across seventh segment, and from the tip of seventh is a still longer and slightly upcurved spine, which, from below, is seen to be rather broad throughout.

Fore wing 9.5 mm. long.

From Mt. Spurgeon, North Queensland, Australia, 3500 to 4000 ft., 26 July (Darlington). Type M.C.Z. no. 22094.

Psyllobetina gen. nov.

A division of Hydrobiosis, with the anastomosis before the stigmal area, discal cell of fore wings open, fork one pedicellate, fork two back to the cross vein from radial sector to medius, forks three, four, and five subequal, in hind wings no fork one, fork two broad at base; female with long, slender, upcurved ovipositor.

The genus Typhiobiosis of New Zealand has the discal cell open, but is otherwise very different.

Psyllobetina plutonis spec. nov.

(Figs. 22, 52, 57)

Head black, with a few pale hairs; palpi brown, antennae brown on basal joints, yellowish beyond; thorax black, with yellowish brown hair; abdomen dull black; legs yellowish brown. Fore wings brown, with scattered black hair, stigma very distinct, black; hyaline white marks as follows: one from medius before forking obliquely up to

forking of radial sector, one over cross-vein from radial sector to medius and extended to the base of fork four, one up from end of anals to base of fork five, a small one from radial sector to radius at base of stigma, and a fine line along upper side of medius; veins brown. Hind wings gray, with black hair and fringe, veins brownish.

In fore wings fork one is long pedicellate, fork two more than twice as long as fork one, fork three shorter and with a pedicel two-thirds its length, fork four very long, almost as far back as fork five, cross-vein from medius to cubitus is strongly bowed outward, and in hind wing still more so. In hind wing no fork one, fork two broad at base, fork three with a short pedicel, fork five almost back to the bowed cross-vein.

Fore wing 7 mm. long.

From Blackheath, Blue Mts., New South Wales, Australia, 18 Jan. (Darlington). Type M.C.Z. no. 22095.

Doliocypta new subgenus of Rhyacophila

This is based on two very small species which in general structure and venation agree with Rhyacophila. They differ however in the remarkable enlargement of the anal cell in the hind wings. This is fully three or four times larger (in proportion) than the anal cell of Rhyacophila (and over one hundred species were examined). The male genitalia are very short, however, but little shorter than in some other Rhyacophilas; there is a triangular tooth on the venter.

Genotype *D. liliputana.*

Rhyacophila (Doliocypta) liliputana spec. nov.

(Figs. 97, 98, 104)

Head reddish brown, mostly dark hair, some on vertex pale, palpi short, long black hair on basal joints; antennae brownish, thorax yellow brown above, darker on sides of mesonotum, some bristles pale, over wing base darker; abdomen almost black above, tip and venter paler, quite long hair above; legs pale, mid tibia rather darker above. Fore wings grayish brown, with some small scattered white spots, most numerous in apical half, in some places almost in bands, most of the fine hair on membrane is golden; hind wings gray, darker near tip, and particularly in the stigmal area.

In fore wings forks one and two about equal, fork three with a

pedicel about equal to fork. In hind wing the anal cell is greatly enlarged. The male genitalia have a short superior plate deeply divided, from side the lower appendages have a large basal joint, convex below, and at tip is a shorter joint, divided into a short dorsal lobe, and a lower part about twice as long with parallel sides. Venter with a small triangular tooth.

Length fore wing 5 mm.

From Wong Sa Smi, South Kiangsi, China, 9 July (Gressitt). Type M.C.Z. no. 23432.

Rhyacophila (Doliocypta) minuta spec. nov.

(Figs. 89, 102)

Small, and similar to *R. liliputana;* head and body darker, legs very pale, abdomen dark. Wings dark, the fore wing less spotted than *R. liliputana.* The fore wing has forks one and two about equal, fork three not as long as its pedicel; a snow white line back from end of discal cell. In hind wing the anal cell is enlarged, much as in *R. liliputana.* The male appendages are very short and compact, the lower outer plates have a small two-jointed appendage, and within is a pair of appendages with a broadly emarginate tip, the upper lobe short, the lower much longer and pale; from beneath the lateral plates show a long inner lobe, and the lower parts of the inner appendages curve toward each other.

Fore wing 4.5 mm. long.

From Dwa Bi, Hainan Island, 20 July (Gressitt). Type M.C.Z. no. 23433.

Agapetus monticolus spec. nov.

(Figs. 56, 59, 64)

Head black, some long, upcurved, white hairs on lower face, and a few above; palpi and antennae dark; thorax black, white hairs from prothoracic warts, dark hairs from near base of fore wing; abdomen dark brown. Wings black, with black hair and fringes, veins brown.

In fore wings discal cell is more than twice as long as broad, forks one and two both broad on discal cell, latter obliquely so, fork three much longer than its pedicel, fork four short, not one-half its pedicel, fork five long, back to the cross-vein.

In hind wings fork two more than one-half its pedicel, fork three nearly equal its pedicel, fork five back to forking of medius.

Male genitalia show a superior median tapering piece, and each side a short very slender, bristly piece, the intermediate pieces project beyond all others and have the sharp point abruptly upturned, the claspers are broad, from side nearly pointed at tip. From the sixth ventral segment is a stout curved process, neither pointed nor broadened at tip.

Fore wing 3.5 mm. long.

From Mt. Kosciusko, New South Wales, Australia, 4 to 6000 ft., 10–12 Dec. (Darlington). Type M.C.Z. no. 22096.

EXPLANATION OF PLATES

PLATE 1

PLATE 1

Fig. 1. Hemicaecilius medialis, fore wing.
Fig. 2. Spiloconis cerata, hind wing.
Fig. 3. Spiloconis cerata, fore wing.
Fig. 4. Notanatolica parva, genitalia, side.
Fig. 5. Smicridea ulmeri, genitalia above, and penis from side.
Fig. 6. Austropsyche victoriana, head above, and penis above.
Fig. 7. Austropsyche victoriana, penis side, and clasper from side.
Fig. 8. Symphitoneura exigua, genitalia from above and below.
Fig. 9. Sciops inermis, genitalia from side, and tip of penis.
Fig. 10. Austropsyche victoriana, superior plate from side, and clasper from above.
Fig. 11. Sciops inermis, clasper from above.
Fig. 12. Zelandopsocus sinuosus, fore wing.

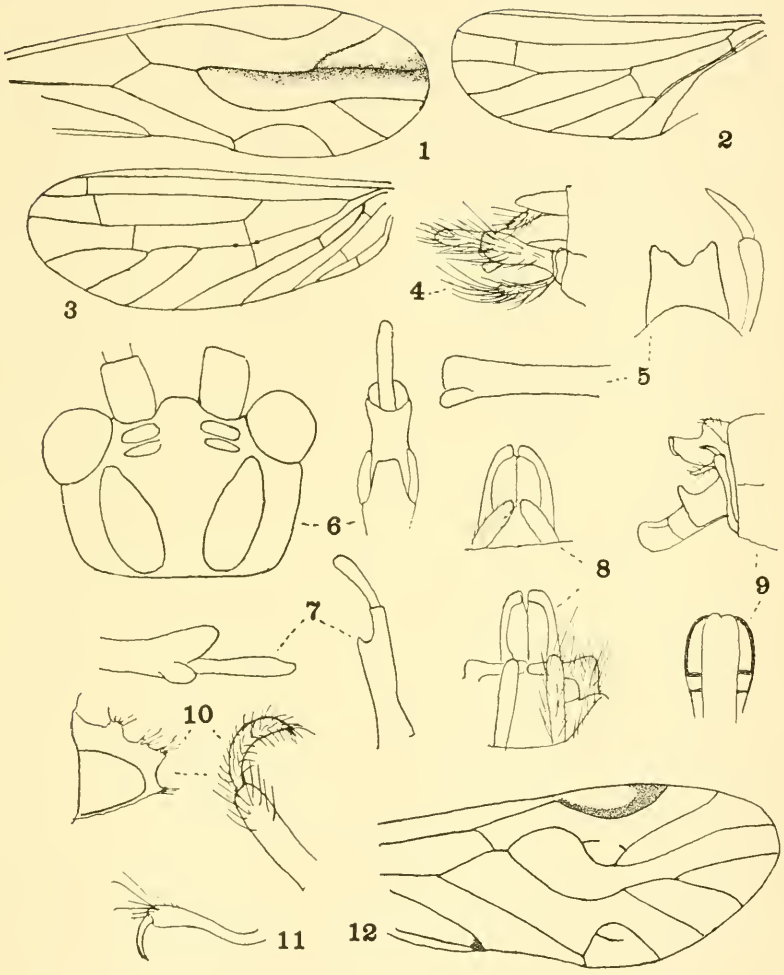
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PLATE 2

PLATE 2

Fig. 13. Theristria medialis, front femur, stigmal area of fore wing, and last ventral segment of male.
Fig. 14. Theristria minor, front femur, stigmal area of fore wing, and last ventral segment of male.
Fig. 15. Theristria stigmalis, front femur, stigmal area of fore wing, and last ventral segment of male.
Fig. 16. Diplectrona angusta, clasper, and penis from above and side.
Fig. 17. Hydropsychodes pulchripennis, superior plate, and genitalia from side, and enlarged tip of clasper.
Fig. 18. Theristria basalis, front femur, stigmal area of fore wing, and last ventral segment of male.
Fig. 19. Hydropsychodes albocincta, genitalia above.
Fig. 20. Hydropsychodes pulchripennis, fore wing.
Fig. 21. Caecilius flavicosta, fore wing.
Fig. 22. Psyllobetina plutonis, ovipositor.

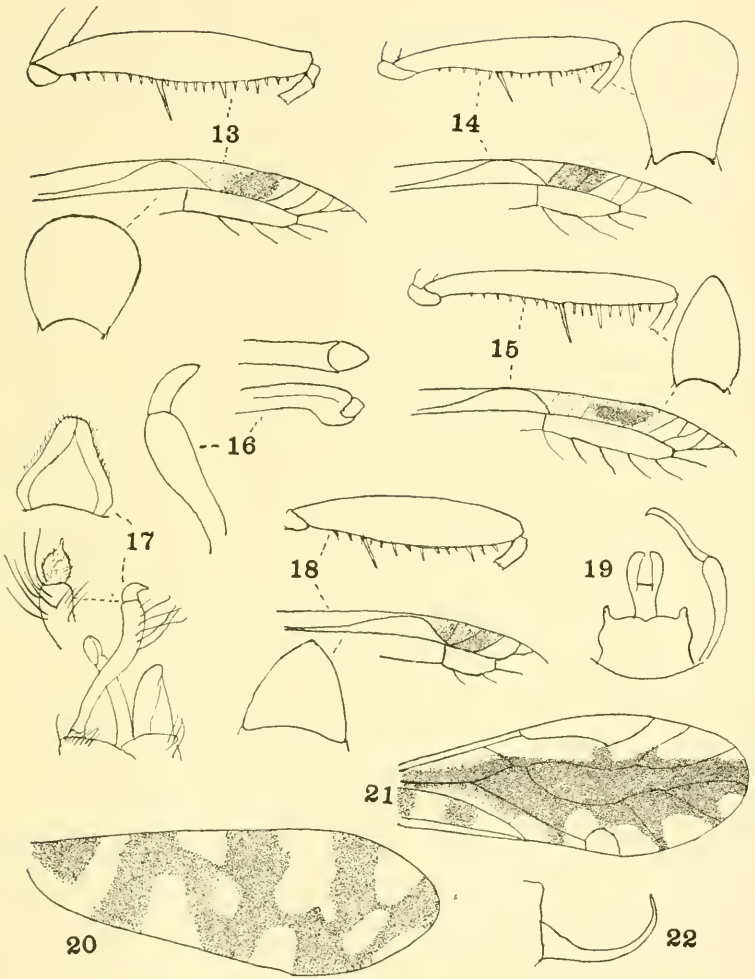
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PLATE 3

PLATE 3

Fig. 23. Claspers, above Macronema pseudoneura, below Macronema ethelda.
Fig. 24. Dyaperla anomala, male genitalia.
Fig. 25. Phanoperla nervosa, genitalia.
Fig. 26. Dyaperla anomala, face.
Fig. 27. Macronema ethelda, superior plate.
Fig. 28. Phanoperla hageni, male appendages.
Fig. 29. Neoperla parva, genitalia.
Fig. 30. Neoperla moesta, genitalia.
Fig. 31. Sciops spinata, penis from side, genitalia from above, and from side.
Fig. 32. Neoperla centralis, genitalia.
Fig. 33. Alloecella grisea, genitalia from above, and from side.
Fig. 34. Alloecella grisea, wings, and part of antenna.

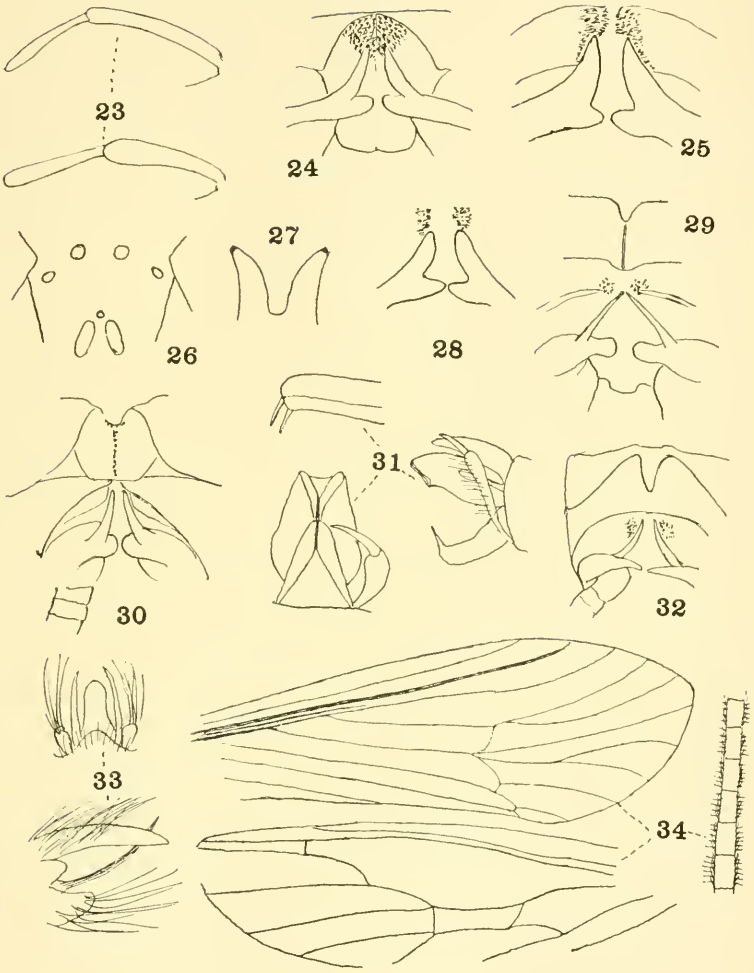
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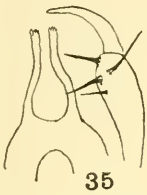
PLATE 4

PLATE 4

Fig. 35. Hydropsyche bryanti, superior plate and clasper above.
Fig. 36. Sisyrina nirvana, fore wing.
Fig. 37. Lingora plicata, fore wing of male, and enlarged view of fork.
Fig. 38. Hydropsyche bryanti, penis.
Fig. 39. Triplectides elongata, genitalia, side.
Fig. 40. Notiobiosis pallescens, wings.
Fig. 41. Smicridea parva, superior plate and clasper, and penis.
Fig. 42. Hydropsyche bryanti, genitalia, side.
Fig. 43. Barynema costatum, fore wing.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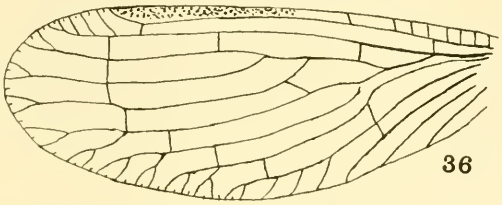
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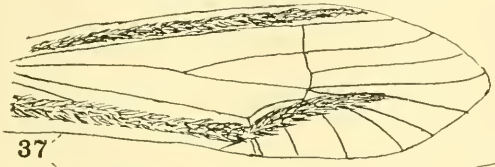
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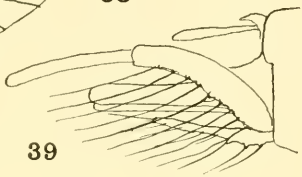
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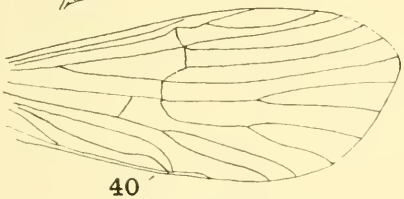
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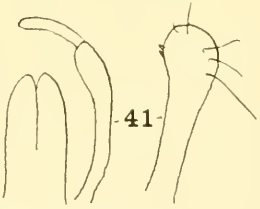
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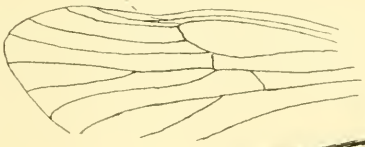

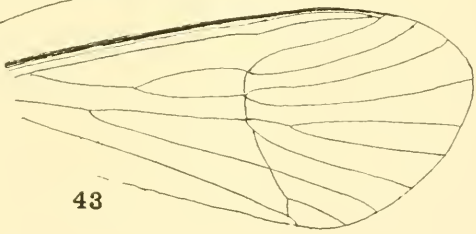
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PLATE 5

PLATE 5

Fig. 44. Lingora plicata, wings of female, and genitalia of male from side.
Fig. 45. Notiobiosis nigrita, hind wing.
Fig. 46. Notiobiosis nigrita, genitalia from side, and fore wing.
Fig. 47. Triplectides australica, genitalia, side.
Fig. 48. Leptocerus darlingtoni, wings.
Fig. 49. Diplectrona angusta, genitalia, above.
Fig. 50. Philopotamus stenocercus, genitalia, side.
Fig. 51. Barynema costatum, hind wing.

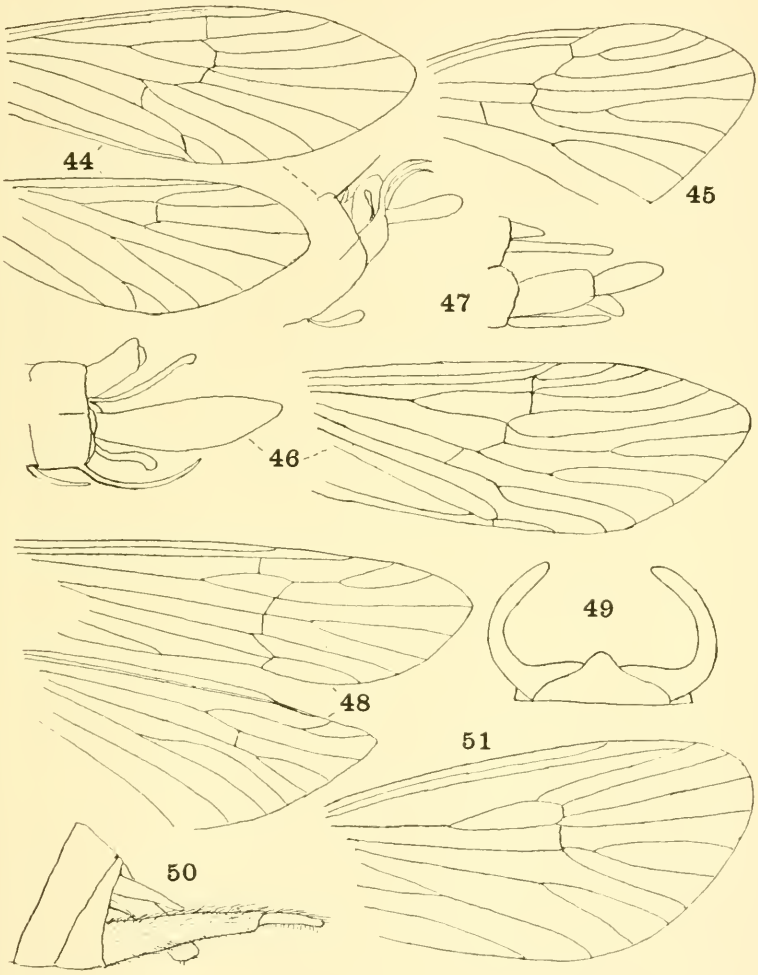
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PLATE 6

PLATE 6

Fig. 52. Psyllobetina plutonis, fore wing.
Fig. 53. Symphitoneura wheeleri, genitalia below, from side, and fore wing of male.
Fig. 54. Barynema costatum, genitalia, side.
Fig. 55. Zachobiella pallida, part of fore wing.
Fig. 56. Agapetus monticolus, fore wing.
Fig. 57. Psyllobetina plutonis, hind wing.
Fig. 58. Macronema tristis, genitalia from above, and from side.
Fig. 59. Agapetus monticolus, genitalia from side.
Fig. 60. Stenopsychodes tillyardi, genitalia from above, and from side.
Fig. 61. Macronema tristis, genitalia from below.

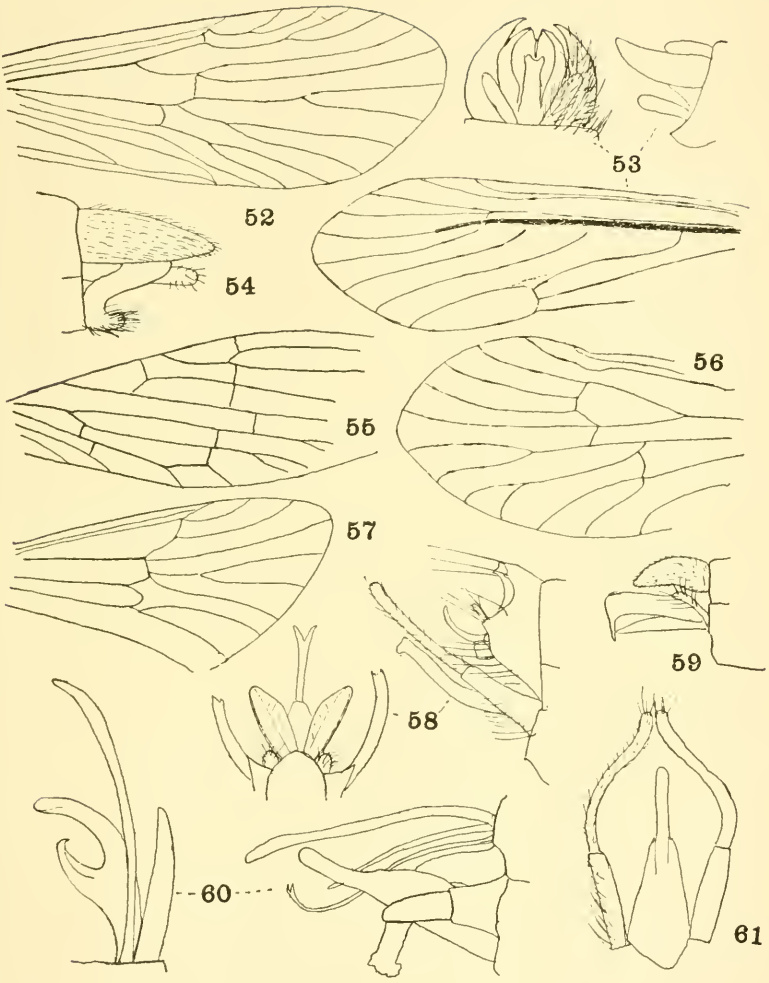
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PLATE 7

PLATE 7

Fig. 62. Notanatolica parva, genitalia from above.
Fig. 63. Leptocerus darlingtoni, genitalia from above, and from side.
Fig. 64. Agapetus monticolus, genitalia from above.
Fig. 65. Plectrocnemia australica, genitalia from side.
Fig. 66. Triplectides australica, genitalia, above and below.
Fig. 67. Molanniella atra, fore wing.
Fig. 68. Molanniella atra, hind wing.
Fig. 69. Plectrocnemia australica, fore wing.
Fig. 70. Symphitoneura wheeleri, wings of female.
Fig. 71. Symphitoneura wheeleri, genitalia, above.
Fig. 72. Notiobiosis nigrita, genitalia from above.

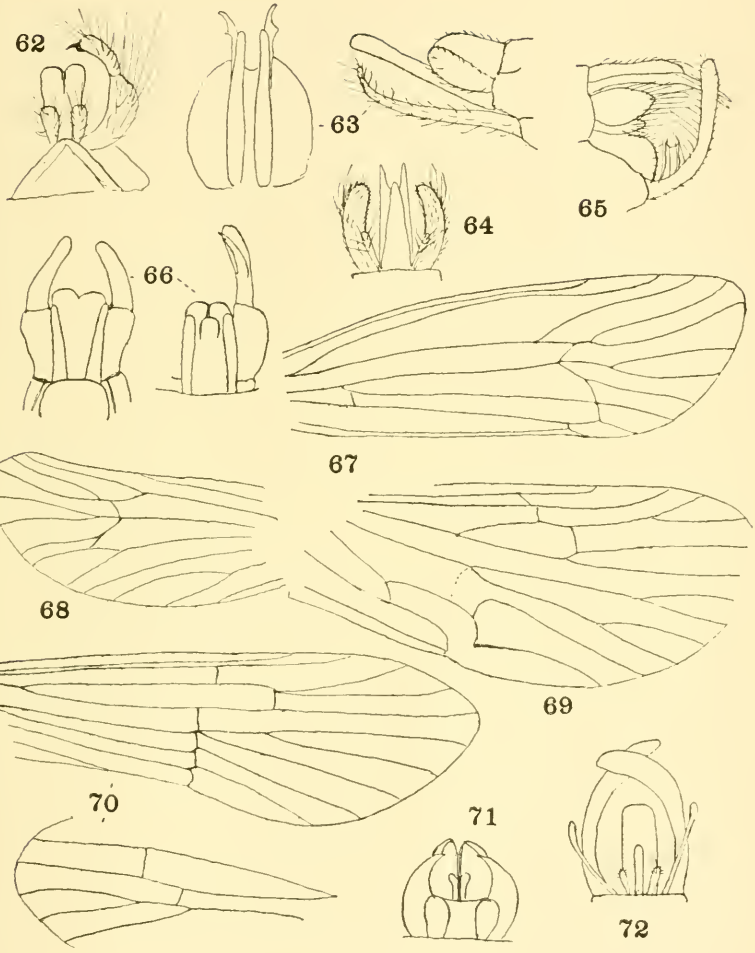
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PLATE 8

PLATE 8

Fig. 73. Ochthopetina nigrifrons, genitalia, above.
Fig. 74. Kiotina resplendens, ventral plate of female.
Fig. 75. Togoperla sinensis, ventral plate of female.
Fig. 76. Togoperla klapaleki, ventral plate of female.
Fig. 77. Kiotina resplendens, male genitalia, above.
Fig. 78. Neoperlops gressitti, genitalia, above.
Fig. 79. Paragnetina insignis, genitalia, above.
Fig. 80. Atoperla chiangi, genitalia, above.
Fig. 81. Togoperla sinensis, genitalia, above.
Fig. 82. Neoperlops gressitti, head, above.
Fig. 83. Neoperlops obscuripennis, ventral plate of female.
Fig. 84. Neoperlops gressitti, ventral plate of female.
Fig. 85. Atoperla chiangi, ventral knob.
Fig. 86. Hydatopsyche decepta, penis from side and above.
Fig. 87. Hydatopsyche decepta, preanal appendage.
Fig. 88. Hydropsyche complicata, clasper.

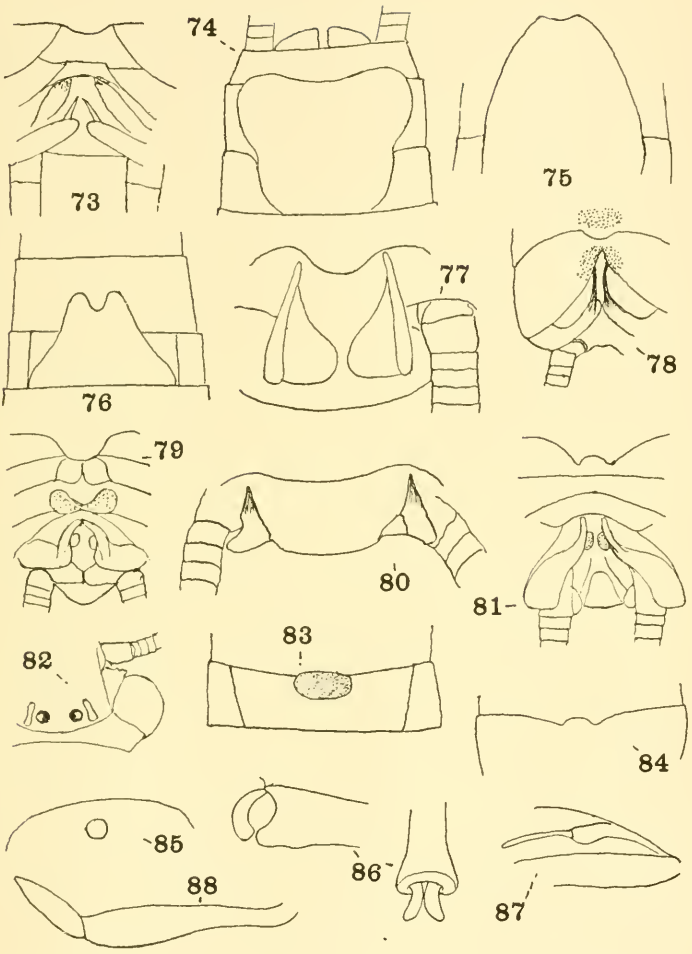
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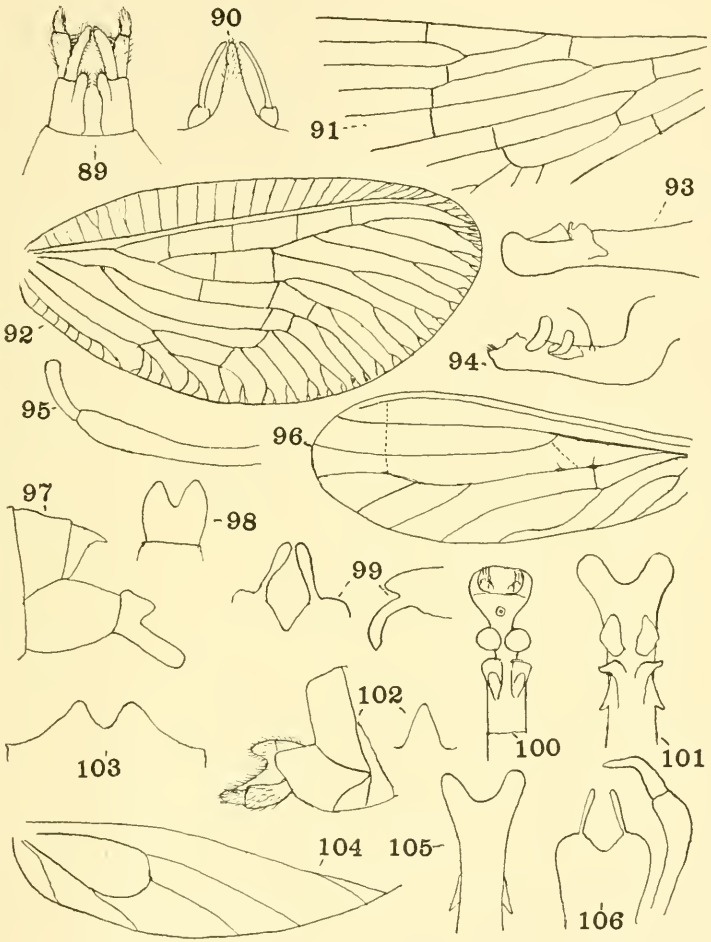
PLATE 9

PLATE 9

Fig. 89. Rhyacophila minuta, genitalia from below.
Fig. 90. Hydatopsyche decepta, superior plate.
Fig. 91. Zachobiella hainanensis, part of fore wing.
Fig. 92. Berothella pretiosa, fore wing.
Fig. 93. Hydropsyche dolosa, penis, side.
Fig. 94. Hydropsyche complicata, penis, side.
Fig. 95. Hydatopsyche decepta, clasper.
Fig. 96. Spiloconis picticornis, fore wing.
Fig. 97. Rhyacophila liliputana, genitalia side.
Fig. 98. Rhyacophila liliputana, superior plate.
Fig. 99. Hydropsyche complicata, superior plate, above and side.
Fig. 100. Hydropsyche complicata, penis, above.
Fig. 101. Hydropsyche dolosa, penis, above.
Fig. 102. Rhyacophila minuta, genitalia, side, and ventral process.
Fig. 103. Oodeia klapaleki, ventral plate of female.
Fig. 104. Rhyacophila liliputana, anal area of hind wing.
Fig. 105. Hydropsyche dolosa, penis from below.
Fig. 106. Hydropsyche dolosa, superior plate, and clasper.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